AGRICULTURAL ENGINEERING

JANUARY 1945

Agricultural Engineers' Interest in Farm Food Processing *Kable, Tressler, Elvehjem*

The Close Relationship of Mechanization to Farm Structures *Frank J. Reynolds*

The Styling of Agricultural Tractors and Other Machines *T. H. Koeber*

Door and Window Design to Eliminate Heat Loss in Dairy Barns *W. C. Krueger*

Results of Tests with an Automatic Tying Pickup Hay Baler *Schroeder and Ackerman*

THE JOURNAL OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

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AGRICULTURAL ENGINEERING

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CONTENTS FOR JANUARY, 1945

Vol. 26, No. 1

EDITORIALS 9

THE AGRICULTURAL ENGINEER'S INTEREST IN FARM FOOD PROCESSING 11
By Geo. W. Kable

VITAMINS AND FOOD PROCESSING 12
By C. A. Elvehjem

PROBLEMS IN FREEZING FOODS 13
By Donald K. Tressler

RELATION OF MECHANIZATION TO FARM STRUCTURES 16
By Frank J. Reynolds

THE STYLING OF FARM MACHINERY 17
By T. H. Koeber

RESISTANCE OF EAR CORN TO AIR FLOW 19
By Claude K. Shedd

THE DYNAMIC PROPERTIES OF SOIL 21
By F. A. Kummer and A. W. Cooper

DOOR AND WINDOW DESIGN TO ELIMINATE HEAT LOSS IN DAIRY BARNS 24
By W. C. Krueger

SHALL THE FARMER BE ENCOURAGED TO CONTINUE DOING HIS OWN CONSTRUCTION WORK? 25
By J. L. Srahan

MAKING HAY WITH AN AUTOMATIC TYING PICKUP BALER 27
By E. W. Schroeder and W. F. Ackerman

NEWS SECTION 29

This Journal is owned, edited, and published monthly by the American Society of Agricultural Engineers.

Editorial and advertising departments at the executive office of the Society, Saint Joseph, Michigan. Publication office at Benton Harbor, Michigan.

The A.S.A.E. is a member of
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
AUDIT BUREAU OF CIRCULATIONS

SUBSCRIPTION PRICE: $3.00 a year, plus an extra postage charge to all countries to which the second-class postage rate does not apply; to A.S.A.E. members anywhere, $2.00 a year. Single copies (current), 30 cents each.

POST OFFICE ENTRY: Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921.

EDITORIAL

Family Farm, Inc.

AS LONG as corporation earnings are taxed at least forty per cent before the remaining sixty per cent or less is again taxed as personal income of the stockholder, it probably is merely a moot question to think of incorporated farms. For this double and discriminatory taxation there seems to be no rational explanation, other than the political fact that corporations have no votes. There now appears a slight hope that this inequity will be corrected. If and when so achieved, it will enable farmers to consider use of the corporate form on its inherent merits.

In soom quarters it has long been customary to speak of corporation farming only in tones of utmost horror. It implies vast acreages worked by wage slaves, starved and stunted by absentee owners of great wealth, flogged to their toil by lineal descendants of Simon Legree. Actually, of course, success is the exception and failure the rule for large-scale farming projects. Strangely, too, the amount of horror held is far less in the case of communal farming, even when countless farmers were liquidated to make way for it.

As agricultural engineers we should be able to lay aside the emotional approach, take off the pink-tinted goggles, and see what the corporate farm promises — not for gargantuan acreages but for the size and sort of place we now call the family farm. Certainly we can see more clearly than others the hazards, handicaps and hardships of purely personal ownership of farm lands and operation of farming enterprises.

The ambitious, capable young farmer who wants to "start on his own" now must choose between the perils of top-heavy mortgage debt or the evils and uncertainties of tenancy. In neither case is there a natural, economic community of interest between the old owner and the young operator. Neither system of succession between generations of farmers is flexible enough to insure sharing of losses and gains equitably through periods of price fluctuation and the varying fortunes of crops yield. Neither system is automatic in encouraging cooperation between the man on the way in and the man on the way out.

With land, livestock, equipment and inventory organized into a corporate entity it should be possible to effect gradual change of ownership over a period of several, perhaps many, years. It should save highly efficient farms from the shock of closing-out sales, and efficient young families from years of struggle with inadequate, inefficient equipment. It should prolong the lives of farmers for whom abrupt retirement too often turns out to be a death sentence.

In some cases, perhaps, incorporation would facilitate the consolidation of acreages too small to permit the use of modern equipment. In the main, however, we believe that farm size would gravitate toward the acreage of optimum efficiency. That size already is pretty well defined in the dimensions of the better class of present-day family farms. Thus the family farm as a social institution, as well as a producing unit, should be strengthened by incorporation.

Not That Kind of Labor

THE headquarters office of the American Society of Agricultural Engineers has received an invitation from a conspicuous labor organization, asking the designation of a representative to attend a conference looking toward the organization of white-collar and professional employees.

The communication declares that its sponsor ". . . . profoundly realizes that the well-being of our Nation and its effectiveness in war and peace demands that every section of our population must be made secure and placed in a position to make their maximum contribution to our country, today for the achievement of victory and tomorrow for the achievement of a durable peace and lasting prosperity."

It continues to state the opinion that "the continued neglect of the economic and social problems of the millions of white-collar and professional employees must be promptly corrected in the interest of the entire nation. Responsibility for enactment of a program directed to this end rests, in the final analysis, on business and government. Nevertheless," it states, "the labor group is prepared to help in every constructive way to enable our country to deal properly with this question."

With such patriotic generalities we can have no quarrel. But we doubt that agricultural engineers have any craving to ally themselves with an organization whose active element seems to have a three-way hybrid heritage — communism and crime crossed with a political mutation. We doubt that they care to enter the ranks of those millions who, while instinctively decent citizens, yet are dumb and docile under the pressures and persuasions of a militant minority.

Agricultural engineers, we suspect, have no great yearning to pay tribute for the right to work, to be told when and how much to work, when to strike, when to picket, when to commit trespass, vandalism and mayhem. We doubt their desire to be told how to vote and to be assessed for involuntary contributions to political funds. We doubt their enthusiasm for a system wherein tenure and promotion are based not on work well done but on mere passage of time.

In particular, agricultural engineers will find it hard to submit to a regimentation whose underlying psychology is titillation of the inferiority complex. They will not readily acquiesce in the repudiation of nearly every principle of sound economics. They will be especially reluctant to become disciples under the apostles of inefficiency. All in all, we expect no upsurge of sentiment for becoming a part of labor with a capital L.

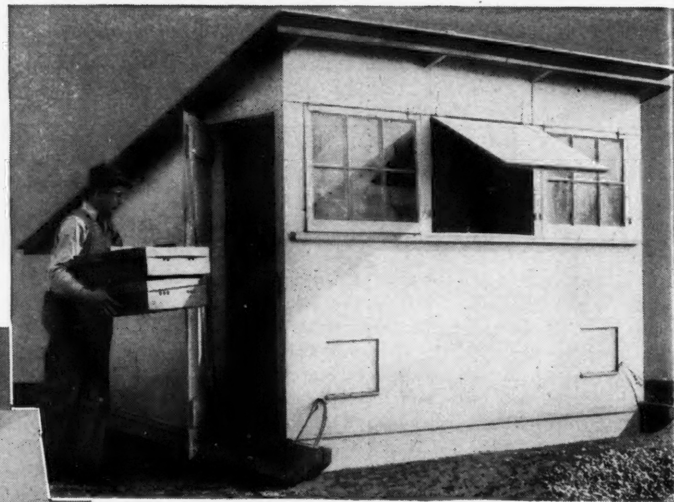
Power to Destroy

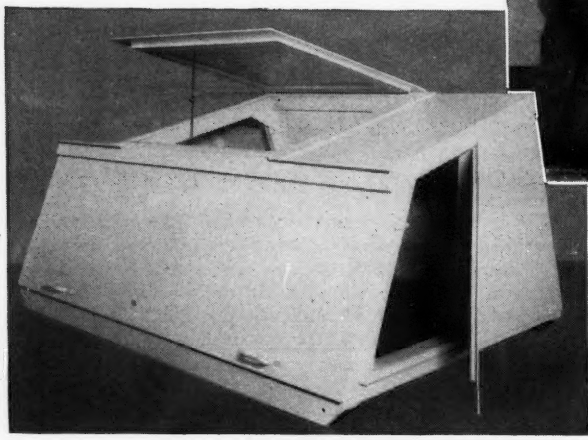
PURCHASE of a whole town of several thousand population, along with its rich hinterland, by a California cooperative for the round sum of ten million dollars recently was reported by the news magazine "Time." At first glance this seems a gratifying achievement by agriculture. But when we dig deeper and see how remote this cooperative is from the actual farmer, and especially when it begins to appear that the whole setup is simply (or mainly) an expedient for tax evasion, our enthusiasm cools.

If we are correctly informed that such cooperatives are or can be set up so as to be entirely free of federal taxation, it means that the cooperative is subsidized to the full amount of federal taxes that would be paid by a corporation with the same amount of earnings. With corporation earnings taxed from 40 to 95 per cent, this is no trifling subsidy. It becomes rather frankly a weapon for the liquidation of any corporation which might presume to compete, and exemplifies the economic axiom that "the power to tax is the power to destroy."

In our humble opinion the cooperative movement would be on more solid ground, and in *(Continued on page 28)*

Where to Use Douglas Fir Plywood For Farm Buildings





(above) Sturdy, practical poultry brooder house of Douglas fir plywood. Only Exterior type plywood (EXT.-D.F.P.A.) should be used in such structures.

(left) The hoghouse of Exterior type Douglas fir plywood has a hinged super-structure to permit easy cleaning.

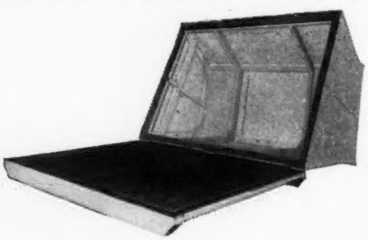
Research in cooperation with Purdue University is proving the merits of Douglas fir plywood for farm construction. Typical small structures such as those illustrated have been tried out in actual use over a period of several years. The 1943 Annual Report of the Purdue Agricultural Experiment Station contains the following report:

"Plywood of exterior grade has been satisfactory as a material for floors, walls and roofs of portable individual hog houses and portable brooder houses for poultry. Plywood approximately one-half the thickness of corresponding matched lumber produced structures which were more rigid but were only two-thirds as heavy as similar buildings of conventional construction.

Temperatures inside the plywood hog houses and brooder houses were not significantly different from those in similar conventional houses, and fuel consumption in hard coal brooder stoves in similar houses built of plywood and of conventional lumber, was approximately equal.

Plywood houses were somewhat tighter than conventional houses, resulting in less air leakage. Larger ventilation openings were necessary in the plywood houses in order to maintain the same relative humidity.

After four years of farm service the plywood hog houses and brooder houses appear to be in as good condition as similar structures built at the same time but of conventional lumber."



HOG HOUSE

Hinged super-structure permits easy cleaning.

Brief Specifications:

Size:
6 x 8 feet.

Floor:
Two 4" x 6" skids. Three 2" x 4" joists placed flat. Floor ½" EXT.-D.F.P.A. asphalt painted. (Sand could be broomed on second asphalt coat to make non-skid surface.)

Walls and Roof:
Framing 2" x 3". Covering can be cut with minimum waste from four ⅜" EXT.-D.F.P.A. panels. Scrap from wall layout used for glued gusset plates.

Door Height:
32" at center.

POULTRY BROODER HOUSE
Brief Specifications:

Size:
10 x 12 feet.

Floor:
Two 4" x 6" skids. Joists 2" x 4" notched into skids 24" o.c. middle joist doubled. Flooring ½" EXT.-D.F.P.A.

Walls:
Studs 2" x 4", 4 ft. o.c. Single thickness wall covering of ⅜" EXT.-D.F.P.A.

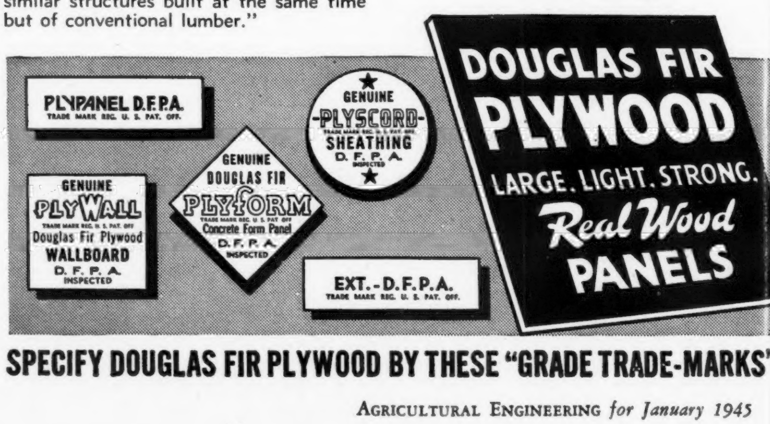
Roof:
Rafters 2" x 4", 2 ft o.c. Roofing ⅜" EXT. - D.F.P.A. Vertical joints filled with white lead paste prior to painting. Horizontal joint lapped 6 inches.

★

Farm Buildings are War Equipment . . . Keep Them Fit and Fighting

★

DOUGLAS FIR PLYWOOD ASSOCIATION
Tacoma 2, Washington



SPECIFY DOUGLAS FIR PLYWOOD BY THESE "GRADE TRADE-MARKS"

AGRICULTURAL ENGINEERING

VOL. 26 JANUARY 1945 No. 1

The Agricultural Engineer's Interest in Farm Food Processing

By Geo. W. Kable
FELLOW A.S.A.E.

THE agricultural engineer's professional interest is in the application of engineering principles to the problems of agriculture. This is true whether the problems be those of drainage or cultivation of fields, housing of livestock and equipment, or processing of foods.

The freezing and storage of frozen foods is the newest of the food processing methods, and the one which is receiving major attention of research workers, manufacturers and prospective users. Let us take it as an illustrative example of the engineers' interest in food processing.

The freezing of foods involves a procedure of selection, preparation, packaging, freezing technique and reconstitution which is being gradually worked out by food chemists, bacteriologists, home economists, and "trial and error" specialists in the home. Generally the food specialists should give the engineer the desirable holding temperature, the necessary rate of freezing, the permissible fluctuations, and the economists should give some idea of size of equipment needed. From there on the engineer's job is to design and build a freezer which will be reasonable in first cost and economical in operation. It must be reliable, and easily operated and maintained. It must be of a size and shape or type of knockdown construction to go through doors to the place of use. It should be designed with sufficient residual cold capacity to carry over expected outages in electric service without spoilage. These requirements involve a choice of structural materials, type and amount of insulation, type of cooling coils or plates, the use and size of eutectic tanks, the design of a single or multiple compartment cabinet with side or top openings, prevention of frosting or provision for defrosting, an economic balance between insulation thickness, eutectic tanks or plates and compressor size, controls, finish, and due consideration to the place in which the equipment is to be used. From the standpoint of manufacture and salability the engineer must also give consideration to ease and cost of fabrication, shipping weights, installation costs and subsequent service. Obviously we have a considerable interest in the farm food freezer while still leaving the problems of design of compressors, controls, refrigerants, insulating materials and other parts to mechanical, chemical and electrical engineers.

While many of us have worked on some of the problems of food processing, probably few have taken the trouble to list those that exist on farms. I shall briefly enumerate some of them. In doing so I have in mind that home processing may become increasingly important as war markets for agricultural products decline. Frequently the more processing that can be done on the farm, the larger will be the share of the production dollar that remains in the farmer's possession.

Butchering is an old farm process. The farm spoilage of meat has been enormous. Modern methods call for quick cooling, aging at temperatures just above freezing, and frozen storage. But there are other engineering aspects of butchering. Hot water is a requirement. Meat grinders are laborious machines. They can be electrically operated. Then there are tool grinders to keep knives sharp, meat pumps for curing, smokehouses, and running water for cleanliness.

Poultry dressing in recent years has become an engineering operation. It involves electrically heated and controlled semiscalders and waxers where temperature control is important. Some farm poultry plants keep the semiscalder constantly heated and ready for use. Rotating, rubber-fingered electric pickers are taking much of the labor out of removing feathers, and doing a better job than hand picking. Quick coolers improve quality and home freezers make a backdoor market at higher prices possible.

Butter and cheese making, in addition to calling for electrically operated separators and churns, is enhanced by starters produced in electrically controlled starter cabinets and by refrigeration. They produce the price differential that adds profit to the operation.

Mechanical *cooling of market milk* is one of the most profitable processing jobs on the dairy farm. The savings over ice cooling often pays the entire farm electric bill. Modern milk coolers with agitated cooling mediums are examples of niceties in engineering design.

Pasteurization of milk is still primarily a plant operation. There is need for a small, reasonably priced, approved pasteurizer for small market milk dairies which are now the chief source of milk-borne diseases.

Dehydration. Since the start of the war, home food dehydrators have probably occupied more hours of engineers' time than any piece of equipment ever devised for farm use. Designs flashed into being. Home food dehydration is now settling down to normal development. Dehydration very definitely has a place in food processing. The design of a satisfactory food dehydrator is not a simple procedure. Agricultural engineers tackled the problem and have done a good job.

Engineered dehydration is much older than the home food drier. The Pacific Northwest has been using artificial *drying* of *prunes, hops and English walnuts* for many years. Prunes are dried on farms in multiple-tunnel driers with fruit tunnels 6 ft high, 30 to 40 ft long and using fans up to 40 horsepower. Hundreds of thousands of dollars have been spent on experimental farm hop driers.

Home preserving by *canning* may not seem to call for engineering skill. Judging from the number of serious accidents which have occurred in the past few years, canning has not been engineered as much as it should have been. There is room now for some serious investigation into why these dangerous explosions occur in oven canning. Some of the equipment most urgently wanted by farm women are water bath and pressure canners that have automatic heat-regulating and timing devices which will relieve the canner from constantly watching gages, clocks and heat regulators, while insuring a product that is properly processed.

Freezing has been mentioned. A great deal of development work is still in progress. Agricultural engineers have pioneered this field. There is need in the postwar period for some sensible engineering advice to farmers to keep them from being sold equipment that is not suited to their needs. There will be many freezers on the market. The American Society of Agricultural Engineers could render a worth-while service now by adopting standards of freezer design that would insure enough insulation for safe and economical operation, refrigerant temperatures and coil areas which would minimize frosting, and compressor sizes and eutectic capacity which would insure against spoilage during periods of reasonable outages.

Preparation equipment for processing also has some engineering aspects. Whether canning, dehydrating or freezing, precooking or blanching of some foods is required. It means equipment for cooking, steaming and cooling. For example, one medium-sized vegetable dehydrator using small trucks loaded with trays had a hood which could be placed over the truck of trays and steam turned in with a hose for blanching without rehandling.

(Continued on page 15)

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at Milwaukee, Wis., June, 1944, as a contribution of the Rural Electric Division.

GEO. W. KABLE is editor, "Electricity on the Farm".

Vitamins and Food Processing

By C. A. Elvehjem

BOTH in war and peace man has been concerned with the preservation of food for varying periods of time. In some cases it is only necessary to process the food so that it may be kept from the time of production until the time of consumption. In other cases the processing must be carried out so that the food can be transported long distances. In time of war the period of transportation may equal one year, or more under adverse conditions. It is also important to point out that in many cases we have two periods to deal with — the interim between harvest and manufacture and the period between manufacture and consumption.

In processing as well as in production greatest emphasis has usually been placed on the total weight of the end product and on the palatability of this product with relatively little interest in the nutritional quality. The roller mill process for making refined flour was invented in 1879 specifically to improve the keeping quality of flour, but it is only within the past five years that a practical solution has been developed for counteracting the loss of essential nutrients during this process. Before refrigeration was available, milk was preserved by making butter, but today we know that the most important nutrients of this food remain in the skim milk. Pasteurization of milk was introduced before definite facts were available to show that this processing had no deleterious effect on the nutritive value of milk. Fortunately today we do know that very little, if any, deterioration takes place.

If we follow the developments in the broad field of food processing, it is evident that the farmers producing animal feeds introduced methods which tended to retain the vitamin content before the food processors recognized the importance of this problem. Improved methods of handling forage crops were developed so that a larger part of the carotene (vitamin A precursor) could be retained. The use of the silo did much to improve the nutritive value of the rations used for the dairy cow. A little later the use of mineral acids allowed the ensiling of alfalfa and other legumes, a process which preserves a very high proportion of the vitamin A potency. This procedure has allowed the production of milk in the wintertime with a much higher vitamin A potency. It is very interesting that this method of increasing the vitamin A intake of humans has been recognized within the past 6 months by the Council on Foods and Nutrition of the American Medical Association as a very important means of increasing the vitamin A intake of our people and it is encouraging farmers to use these methods more widely.

The tunnel drier, which is so extensively used today for the dehydration of human foods, was first used for the dehydration of alfalfa and other forages. The retention of the green color, and therefore vitamin A and vitamin C, naturally attracted a good deal of attention among the early workers. The reason for this retention is, of course, dependent upon the fact that the temperature of the plant material itself remains very low due to the rapid evaporation of water. I might, however, point out that this procedure does not destroy some of the oxidative enzymes, and therefore more rapid breakdown of the carotene takes place after drying than if the material had received a little higher heat-treatment.

With the more general recognition of vitamins by the public a much greater interest has been taken in the preservation of these substances in human foods. Unfortunately there seems to be a very prevalent idea that all vitamins are easily destroyed and lost in most foods especially when large-scale methods of handling are used. We still find individuals who have the idea that vitamins are ready to jump out of foods onto the cooling coils of the refrigerator or the lids of cooking utensils. These ideas are undoubtedly dependent upon past experience, namely, that the most serious vitamin deficiencies have usually been encountered when a large portion of the diet has been overprocessed and that difficulty in preventing loss of activity of certain vitamins during isolation procedures was usually encountered. For several years every discussion involving food or vitamins was followed by questions about their stability during processing and cooking. Usually these questions were answered by the simple statements that vitamins A and C are readily destroyed by oxidation, that vitamin B_1 is inactivated by moist heat, and that all the B vitamins and vitamin C are apt to be lost in the cooking water because of their great solubility. Little attention was given to the degree of loss or to the fact that the amount lost varied with the processing procedure.

Naturally it was impossible to make any systematic studies until figures were available for the vitamin content of the original foods. Many of you may think that figures for the vitamin content of foods have been available for many years, but this is not the case. It is only within the past 3 or 4 years that improved methods have made possible extensive and systematic analysis of all foods. Attempts to tabulate the vitamin content of all foods were started only a year or two ago. Even before these figures were tabulated there was much agitation against them on the basis that most foods were processed and cooked before consumption and therefore only the values for cooked foods were of any significance. Fortunately these objections did not hinder the necessary tabulations and in the meantime important results on processing and cooking losses have been accumulated.

There are, of course, several approaches to the study of vitamin retention in foods. First, we might determine and tabulate the vitamin content of foods as they are ready to be served on the table. Second, we might select certain typical foods and the most common methods of processing and determine the average percentage retention for each of the vitamins. I am inclined to favor the latter method although I am well aware of all the dangers of making generalizations. The reason I favor the latter method is because it indicates where the losses occur and this gives us some opportunity for improving our procedures so that losses may be prevented. Even in the latter method we encounter certain difficulties. Different samples of the original food may vary considerably. The thiamine content of pork may vary from 0.7 to 1.5 mg (milligrams) per 100 g (grams) fresh meat. The ascorbic acid content of raw tomatoes may vary from 4 to 21 mg per 100 g. This difficulty is largely eliminated when the percentage retention is calculated, although the percentage loss may be different when the original food is high in a specific vitamin than when this value is low to start with. The calculations may be made in one of two ways. The original sample may be divided and the two parts paired as accurately as possible; one part analyzed directly and the other weighed and processed, after which the entire sample is ground and analyzed. By this method, it is possible to measure the total amount of vitamin which was placed in the vessel and the total amount remaining after treatment. This method is especially valuable when you wish to measure the amount lost in the cooking water from vegetables or the drippings from meat. In the other method, the vitamin content may be expressed per unit weight of dry food or unit weight of protein before and after processing. In this method a small aliquot may be taken in each case. However, one must be certain that the aliquot is typical of the entire sample. Serious errors have been encountered in studies on meat by taking a small sample of the surface of a roast before and after roasting. It is obvious that the loss of B vitamins is greater from the surface of a roast than from the interior. The latter procedure is more applicable to studies on large-scale cooking. It does, however, involve the extra determination of the dry matter in both cases.

If we are to determine the loss by any processing procedure we must be certain of the vitamin content of the original food. In many cases the loss, especially of vitamin C, is greater between the time the food is harvested and processing is started than during all the remaining procedures. This emphasizes the importance of handling the food properly immediately after harvesting. I will give just one example to emphasize the importance of this procedure as compared to losses during cooking. Fresh spinach may contain 80 mg of vitamin C per 100 g, but if it is left at room temperature for 2 days the value is reduced to 23 mg. If special precautions are taken in cooking this spinach, you may reduce the loss from 90 to 50 per cent, a saving of 10 mg of the vitamin. But by proper refrigeration prior to cooking, it would have been possible to save 57 mg. Little if any destruction of the other known vitamins takes place during ordinary handling of (Continued on page 15)

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at Milwaukee, Wis., June, 1944, as a contribution of the Rural Electric Division.

C. A. ELVEHJEM is professor of biochemistry, University of Wisconsin.

Problems in Freezing Foods

By Donald K. Tressler
MEMBER A.S.A.E.

THE freezing of foods in locker plants and home freezers is very popular at present. Most of the locker plants have a waiting list. Used freezing cabinets are selling for more than their original cost. Both city and rural housewives and also farmers are preparing, packaging and freezing foods of all kinds. Interest in freezing foods is surprisingly widespread.

If freezing cabinets were now available, there is little doubt but that they would be purchased in large numbers even if they were sold at a high price. Will this interest continue in the postwar era when all kinds of foods of high quality are abundant and can be purchased everywhere? The postwar planners have reached the conclusion that the end of the war will bring a big boom in the sale of both food freezing equipment and frozen foods. Although many of the postwar planning ideas seem to me to be a little off the beam, I am inclined to agree that the freezing of food in cabinets and lockers will be popular and that the great demand for freezing cabinets and walk-in freezers will continue. But before placing our bets, let us consider some of the unsolved problems and the precautions which must be taken if a product of good quality is to be obtained.

If the freezing of foods in the home is to be popular, the methods used must be simple and practical and the quality of the food must be high. If the frozen products when served on the table are not substantially the equivalent of cooked fresh foods, the public will tire of them. It is therefore of importance that we know the best procedures for preparing and freezing foods and disseminate this information widely so that everyone using a freezer will know how to obtain products of high quality.

Meat Freezing Problems. The butchering, chilling and cutting of meat are not simple operations which can be easily carried out in the average home. Many persons, especially housewives, do not care to butcher their own animals. Very few homes have coolers of the right size and temperature to be suitable for the chilling and aging of freshly slaughtered carcasses. In the late autumn, winter and early spring, when the weather is cool, the carcasses may be chilled, and only under especially favorable conditions may be aged in unheated buildings. If meat freezing is dependent upon weather conditions, the meat will have to be watched very closely during chilling and aging; otherwise a serious loss of valuable product may occur. This is especially true in the case of beef which should be hung for at least four or five days before being cut up and packaged.

It is evident that even though freezing cabinets become very common, still there will be a very real need for complete service locker plants to provide butchering, chilling, meat cutting and packaging service. The locker plant operator should charge sufficient for these services to enable him to make a profit, even though lockers are not rented to the patron.

Even today, with satisfactory packaging materials available, much of the meat now being frozen is not being properly protected against desiccation and oxidation. Waxed papers are more commonly used than any other type of wrapper and little of the waxed paper on the market is sufficiently moisture and vaporproof to be satisfactory for the packaging of a valuable product such as meat.

Further, waxed paper will permit the transfer of odors. If meat is packaged in waxed paper, it should not be placed in close proximity to smoked and cured meats. Otherwise there will be a transfer of the odor and flavor of the cured product.

Relatively few persons use stockinettes over the wrapped meat. While it is true that the stockinette is not absolutely essential, yet it presses the wrapper tightly down on the surface of the moist meat, thus providing a substantial moisture and vaporproof skin which provides ideal protection, provided the wrapper is actually moisture and vaporproof.

Special coated moistureproof vegetable parchment papers, moistureproof cellophanes, pliofilm and rubber-latex bags are ideal materials for wrapping and packaging roasts and large cuts of meat. Unfortunately the last two materials contain rubber and are not now available. Steaks, chops and other relatively small cuts of meat should be packed in cartons lined with moistureproof sheeting. Hamburg steak and sausage may be packed either in a container of this type or in a heavily waxed carton.

The proper packaging of meat and poultry is important, not only to prevent loss of weight of the meat but also to keep a protective film of ice which prevents direct contact of the oxygen of the air with the surface fat, thus greatly retarding the development of rancidity.

Meat should be kept at a temperature of 0 F (degrees Fahrenheit) or lower. Low temperatures are especially desirable in the case of pork, since pork fat oxidizes easily and soon becomes rancid at higher temperatures.

Frozen meat is somewhat more difficult to cook than the fresh product. This is particularly true of roasts which are difficult to thaw. The larger cuts of meat should always be thawed prior to cooking as otherwise the meat will not be cooked uniformly. If a solidly frozen roast is placed in an oven at 350 F or higher, the exterior will be well cooked long before the interior even warms up.

Freezing of Poultry. Most housewives and farmers can kill, pick, wash, clean and package their own poultry without great difficulty even in warm weather. However, on many farms sanitation is a problem. It is unwise to try to prepare poultry for freezing in hot weather unless adequate facilities are provided for the cooling. Further, it is important that an ample supply of clean water be provided for washing and that this be carried out in a manner which will not contaminate the product.

There is a layer of fat directly underneath the skin of most birds. The fat of chickens, ducks and turkeys is relatively soft and consequently oxidizes and becomes rancid easily. On this account, it is of great importance to package poultry in such a way as to prevent desiccation during freezing and cold storage. Poultry is even more difficult to package properly than is meat since the birds have such an irregular shape. It is of importance to use a flexible, preferably a pliable, moisture and vaporproof sheeting together with stockinette. If stiff paper is used without a stockinette, the poultry may desiccate and oxidize, even though the paper is moisture and vaporproof.

Low storage temperatures are very important if the frozen poultry is to be stored for longer than two or

The Victor (General Electric) farm freezer with the cover removed to show the refrigerating unit

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at Milwaukee, Wis., June, 1944, as a contribution of the Rural Electric Division.

DONALD K. TRESSLER is manager, Consumers Institute, General Electric Co.

three months. The lower the storage temperature, the longer the product may be kept before rancidity develops. A temperature of zero degrees is satisfactory for six to eight months. If storage is to be for a longer period, a temperature of −10 F should be maintained.

Dairy Products. Freshly frozen milk can be thawed out and then can be scarcely told from milk which has not been frozen. Milk which has been held in the frozen condition for a few months coagulates during storage and becomes undesirable. For this reason, it is unwise to store frozen milk for longer than a month or two. In a somewhat similar manner, slow frozen cream gradually changes during storage and eventually (after about four months) becomes stiff and partially separates. Further, it soon becomes a little tallowy and slightly rancid. Pasteurization at a slightly higher than normal temperature or for longer than the usual thirty minutes will inactivate a considerable proportion of the oxidative enzymes. Cream pasteurized in this way is less subject to tallowiness and rancidity than cream which has not been thus treated.

If eggs are frozen and held at temperatures below 22 F, the yolk jells. The white is not affected. If the yolks and whites are stirred up together and then strained, the product thickens upon freezing but does not become a solid jelly. It is a relatively simple matter to prevent jelling of egg yolks by adding corn syrup, sugar, vinegar, salt, glycerine, or some other easily soluble substance which does not affect the food value of the egg. The proportion of soluble substance required to prevent the jelling of the yolk will depend upon the product. Usually the amount added is approximately 5 per cent. Smaller amounts are required for whole eggs than are needed in the case of straight egg yolk.

Freezing of Vegetables. Most persons who have frozen vegetables in freezing cabinets and lockers have been very well pleased with the quality of the frozen products. However, all those freezing vegetables have not reported equal success. Difficulties have been encountered in the case of snap beans, asparagus, corn on the cob, and a few other vegetables.

If frozen vegetables of high quality are to be obtained, it is necessary to take certain simple precautions. For instance, not all varieties of any vegetable give an equally desirable frozen product. Frozen Kentucky Wonder beans are about the only variety which is fully the equivalent of the fresh product. Other varieties which are satisfactory include Blue Lake, Lowe's Champion, Giant Stringless Green Pod and the Wisconsin Refugee. Care in the selection of the proper variety must also be taken in the case of lima beans, green peas, sweet corn and many other vegetables. Overmature vegetables become stringy on freezing. Therefore, it is of great importance to choose products for freezing which are just right for immediate table use. Certain vegetables, for example, sweet corn, asparagus, green peas and snap beans become stale very quickly after picking unless they are quickly cooled to a temperature of about 35 F. It is important, therefore, that the housewife should either cool her vegetables promptly or prepare them for freezing immediately after harvest.

A GREAT STEP FORWARD IN FREEZING VEGETABLES

Prior to 1929 it was not thought possible to freeze vegetables. In that year the value of scalding (precooking or blanching) was discovered. This resulted in a great step forward. Since then the proper periods and methods of scalding all of the common vegetables have been worked out. Fortunately this information has been widely disseminated and is on the whole accepted. However, during the past year certain uninformed persons have indicated in popular articles that the blanching treatment was unnecessary. These statements have created considerable confusion which should be cleared up immediately before large quantities of food are damaged.

There is considerable difference of opinion as to which is the better — steam or boiling water blanching. In commercial operations, steam blanching is probably decidedly superior to water blanching for the reason that steam causes less leaching of water-soluble components, such as vitamins, sugar and flavors. Further, if hard water is used in blanching, it may actually toughen the vegetable tissues. On the other hand, the average kitchen does not have suitable facilities for the production of steam in sufficient quantities to effect adequate blanching in the time ordinarily specified. Further, it is difficult for the housewife to agitate the vegetable during steaming. Products, such as spinach, tend to mat together during the steam blanching. This prevents the penetration of the steam into the mass and results in spotty blanching.

Importance of thorough chilling of blanched vegetables is sometimes overlooked. It seems to me that chilling to a temperature of 50 F is one way of eliminating danger of spoilage of vegetables which comes from either slow freezing or delay in freezing. If the fine flavors, bright colors and full vitamin content of frozen vegetables are to be retained, it is necessary to store them at temperatures of 0 F or lower. At 10 F, for instance, there is a rapid loss of vitamin C content during the storage of nearly all frozen vegetables. A loss of color and quality occur simultaneously.

Freezing of Fruits. In selecting fruits for freezing, it is also of great importance to choose the kind of fruit which freezes well and a variety which gives a good frozen product. As yet methods of preparing bananas and pears for freezing have not indicated processes of treating these fruits which will give a desirable frozen product. Only a few varieties of peaches are especially adapted for freezing. The Hale Haven, J. H. Hale, South Haven, Veefreeze and a few others give a superior frozen product. The common Elberta peach must be handled with great care if a product of fine quality is obtained. As a rule, white peaches do not give satisfactory frozen products. The selection of proper varieties is equally important in the case of strawberries, raspberries and several other fruits.

FACTORS IN THE FREEZING OF FRUITS

Care should also be taken to pick the fruit at the soft-ripe stage of maturity. Immature fruits usually produce frozen products of poor flavor, color and texture. Berries should be frozen soon after picking as otherwise much of the flavor will be lost. Berries and cherries should be washed in water containing ice. If warm wash water is used, the product will be mushy and undesirable.

Most fruits oxidize easily. The addition of sugar or syrup and the use of low storage temperatures retard loss of flavor, color and vitamin content. Here, again, storage temperatures should be 0 F or lower.

Slow Freezing. Quick freezing is not absolutely essential in the case of many foods. On the other hand, very slow freezing is bad practice and also risky. It is poor policy and also dangerous in the case of vegetables to overload a freezer. It is important that the freezing cabinets be rated according to the quantity of food which may be frozen therein in 24 hours during summer weather conditions. The cabinet owner should be warned never to attempt to freeze more than this quantity of food at any one time. If vegetables are chilled down to 50 F or lower prior to being placed in the freezer and are then placed in the freezer while at that temperature, there is relatively little danger from overloading. If, on the other hand, the vegetables are not properly cooled and are placed in a freezer while still at a temperature above 70 F, there is a very real danger that the products may sour and perhaps even turn putrid before they are frozen. If vegetables putrefy, they will become dangerous to health. It would seem important, therefore, for us to urge the need for chilling of vegetables and also to emphasize the danger of overloading a freezer.

One other point is worthy of mention. Many farmers and housewives do not watch their freezing cabinets closely and, if the power or the refrigeration machinery fails for any reason, the cabinet may warm up without the owner being aware of its condition. For this reason, it would seem to be important that each cabinet be equipped with some foolproof alarm device which will warn the owner if the power fails or the temperature rises beyond 10 F.

In conclusion, it may be said that it is possible to produce foods of very high quality in an ordinary home freezing cabinet. Further, I can see no reason why the average housewife will have difficulty in freezing foods of high quality. Most housewives are accustomed to following directions carefully in the canning of foods and in many other food preparation operations. In many ways, the preparation of foods for freezing is simpler than preparation for canning. Certainly the freezing operation is less laborious. For these reasons I feel confident that the freezing of foods will become increasingly popular as the years go by. Nevertheless, it should be pointed out that care must be taken in the preparation and freezing operations, or otherwise the results may be disappointing. If the average quality of the frozen food is not superior to that of home-canned foods, the housewife will lose her enthusiasm for freezing and the sale of freezing cabinets will receive a setback.

Vitamins and Food Processing

(Continued from page 12)

harvested products during a period of a few days or until they are not longer edible. Cereals may be stored for long periods of time with little loss of the B vitamins although there may be some destruction in large bins of grain if the moisture content is high when the grain is placed in storage.

At the present time a large part of our foods are dehydrated which greatly simplifies the transportation problem. In 1943, 50 million pounds of fruit, 350 million pounds of vegetables and 200 million pounds of soup were prepared. The retention of vitamins in these products depends upon many factors. First, the amount remaining in the final product is directly dependent upon the amount present in the raw food before processing is started. For example, potatoes shortly after harvesting contain 15 to 20 mg of vitamin C per 100 g, but after they have been in storage for 4 to 6 months the amount is reduced to 2 to 8 mg. This change is readily evident during analysis of production samples of dehydrated potatoes throughout the year. Most products are blanched before dehydration and in many cases the greatest loss takes place during this step. Two methods of blanching have been used, hot water and steam, but the latter is preferred since the soluble nutrients are lost to a large extent when water is used. In this connection it is interesting to note that Melnick and coworkers have recently shown that hot water blanching of beans is more effective in destroying the natural enzymes than steam, but the steam blanching method is to be preferred because of the smaller loss of the vitamins due to leaching.

STEAM BLANCHING AIDS PRESERVATION OF VITAMINS

Steam blanching plus a sulphur dioxide spray aids greatly in the preservation of vitamins A and C; 1000 to 2000 ppm (parts per million) of SO_2 on dry weight basis for cabbage gives a final SO_2 concentration of 30 to 80 ppm in the cooked product which is barely detectable by taste. Although SO_2 helps in the retention of vitamins A and C, it is especially destructive of vitamin B_1. During the commercial dehydration of cabbage one-third to one-half of the ascorbic acid is lost. Potatoes lose vitamin C to about the same extent, although as high as 80 per cent may be lost. The loss of thiamine for most vegetables varies from 25 to 50 per cent. Carrots lose more of this vitamin during the blanching than during dehydration; cabbage more in the dehydration, and potatoes about equally in the two processes. Most of the riboflavin and niacin is retained in vegetables during dehydration although some may be lost during blanching. The use of natural gas in dehydration gives a much better preservation of vitamin C and also helps in the retention of vitamin A. Dehydrated cabbage with 100 per cent retention of the original vitamin C has been made by this process.

Rice and Robinson have recently reported that dehydrated beef retains 76 per cent of the thiamine, 105 per cent of the riboflavin and 92 per cent of the niacin in the raw meat. Dehydrated pork retains 63 per cent of the thiamine, 104 per cent of the riboflavin and 92 per cent of the niacin in the raw meat.

I am sure that most people believed until a short time ago that dehydrated foods would keep for long periods of time and that there would be no further loss of vitamins after the original processing. This is far from the case, especially if the dehydrated products are kept at elevated temperatures. Recent studies by workers at the Continental Can Company indicate that the storage life for most dehydrated vegetables in air at 75 F (degrees Fahrenheit) is 6 months to one year and in gas the life is extended to one year or more. At 98 F many of the products are no longer edible after a few weeks storage in air and after several months when packed in gas. Along with this total deterioration, some of the vitamins, especially C and B_1, disappear rapidly.

The loss of thiamine in dehydrated meat is very extensive at temperatures above 80 F. It is evident therefore that even dehydrated foods must be stored under proper temperature control if we are to maintain the edible and nutritional qualities. Some of the difficulties may be prevented by reducing the moisture content of the dehydrated product to a still lower level. Many products contain 5 to 10 per cent residual moisture. Thiamine retention in dehydrated meat with only 2 per cent moisture is greatly improved.

Although large volumes of food are preserved by canning little attention has been given to the specific loss of vitamins during the various steps in the canning procedure. A few preliminary results are now available but it is still impossible to make any broad generalizations. A few typical results can be presented.

In the case of vitamin C, citrus fruits and juices can be canned with practically no loss. Extensive studies within the past few months indicate a retention of over 97 per cent of the vitamin C in grapefruit juices during canning. The loss of vitamin C during canning of asparagus is 5 to 25 per cent, beans 50 to 70 per cent and lima beans as high as 75 per cent. Most of these losses take place during the blanching procedure and are due to both oxidation and leaching. Most products show a loss of 30 to 50 per cent of thiamine during the entire canning procedure. In this case, losses occur during blanching, washing and processing. Riboflavin losses for several different products vary from 0 to 35 per cent. In this case most of the loss occurs during the blanching process. There may also be some loss of niacin especially in beans that are very ripe and all the loss occurs during the blanching process due to the leaching. The results indicate that there is considerable variation from plant to plant and that there are many possibilities for improving the processing conditions so that the losses will be greatly reduced.

In spite of every effort to retain the vitamin content during the handling of foods we must recognize that the possibility of loss during cooking always remains. First, I should like to say that cooking losses are not as extensive as some people would have you believe. It is true that poor cooking conditions may produce large vitamin losses, but if any reasonable effort is used, a fairly high percentage of the vitamins may be retained. Fenton, for example, has shown that when commercially dehydrated vegetables are steamed in quantities of 75 to 85 per cent of the thiamine content remains. The rest of the thiamine was found in the cooking water remaining after the processing.

From this brief survey it is evident that much more work remains to be done on the nutritional quality of foods during processing. As engineers, I am sure that you have ideas for the development of new methods of processing and cooking foods. As these new techniques are developed it is important to study the vitamin retention as well as the consumer appeal of the final products.

I should also mention that I have discussed in this paper only the better known vitamins and that there are still several unidentified factors which appear to be very unstable. As time goes on it may be equally as important to study the retention of these factors in foods during processing as the factors we have discussed today.

Ag Engineer's Interest in Food Processing

(Continued from page 11)

In providing equipment for food processing, the logical procedure might be for the farmer or the food expert to present to the engineer the need for the equipment and the requirements it must fulfill. In practice, it seldom works that way. In the past, the engineer in scouting for ways in which he can apply his engineering ability to aid farmers to better farm living, better farm income and products of better quality, has uncovered the possibilities for development. No one has told him the size of freezer needed, the temperature that must be held or the required speed of freezing. He has analyzed the problem, built the equipment and tried it out. At a certain stage in the development the food chemist and bacteriologist have come to his assistance and the development becomes one of progression. That will probably always be the sequence of development since there are no problems of size, temperature or control until there has first been a conception of the equipment or process and a crude attempt to accomplish what is wanted.

The engineering problems involved in food processing equipment are diverse. There is structural design of buildings, cabinets and equipment and the selection from a wide variety of materials. For example, will new freezing cabinets be of steel, water-proof plywood, glass or plastic? Mechanical and electrical design is entailed in the control, heating, cooling and mechanization of the processes. Then there are the problems of safety, reasonableness of first cost of equipment and of operating cost, both of which are factors of design. The effectiveness of the equipment, its foolproofness, the wiring necessary to supply it and its permissibility on rural lines pose other engineering problems.

The agricultural engineer without question has not only an interest but an obligation in the farm processing of foods.

Relation of Mechanization to Farm Structures

By Frank J. Reynolds
ASSOCIATE A.S.A.E.

THERE is a close relationship between farm buildings and farm machinery. But machinery has been modernized to meet the farmer's needs while farm structures have not been so modernized. Improved farm machinery has made it possible for old men, women, and children to do much of the work on the farm while young men have gone into other industries or to war. In addition, farmers with new types of machinery are aiding materially in feeding our allies and the conquered peoples. Many of us believe that if farm structures had kept pace with farm machinery the contribution which the farmer could have made in this time of national crisis would have been still greater.

Improved farm machinery has been responsible for bringing about some new farm structures and for improving some structures already in existence. The silage cutter has been responsible for the development of the silo where chopped forage crops are stored at a tremendous saving in feed value and labor. Hay balers have made it possible for the farmer to store his hay more satisfactorily in one-story hay barns instead of piling it in the once-prevalent huge barns or stacking it outside to be at the mercy of the weather. Grain combines have been followed by new-type storage bins. Barn curing of hay is making rapid advances and it is altogether probable that some new type of farm structure will be developed to facilitate this process.

Special mechanical devices are being developed for the handling of feed and manure in stables. They will make it possible for the farmer to devote less time per head to caring for his livestock, and more animals can thus be raised per man. Milking machines have reduced the once-arduous task of milking to a simple chore. Milking machines have been followed by improved milk houses where the product is cooled and sealed for market.

I repeat: farm mechanization is ahead of the functional developments of farm structures. The function of machinery has been carefully studied; industry is thus in a position to serve better the farmer's machine needs. The functions of farm buildings have not been studied on the scale that the functions of machinery have been.

It is possible for farm buildings, if properly studied, to make an added contribution to our advancement. The U. S. Department of Agriculture and the state agricultural colleges and agricultural experiment stations aided by cooperation of industry have already done some work in the field of functional requirements of grain storage structures and dairy barns. If these public agencies would do more cooperative and well-coordinated research on the other farm structures, I am sure they would discover facts and develop procedures that would result in greatly improved farm structures.

These same agencies now spend all together about $200,000 per year on farm building research. This represents less than 4 cents per farm, or 0.02 of one per cent of the appraised value of the farm buildings. With these very limited means, the federal and state organizations have already done much. Recently they have added to their accomplishments by setting up a tentative list of functional requirements for hog housing, dairy cattle housing, and poultry housing. This is commendable. This limited research has helped to remove some of the chance element for the farmer who desires to purchase such housing. Also, this list, even though tentative, is of inestimable value in aiding industry to adapt its products to meeting the needs of the farmer. If there were more of this type of research, functional requirements of other farm structures could be studied further and the farmer would be correspondingly benefited through improved structures. The agencies which supply structural materials would also be in a better position to meet the needs of the farmers they serve.

Most of the buildings now on the American farm were built when material and labor were cheap. We do not know whether or not such a time will ever exist again. The farmer with his conservative nature is loathe to invest in buildings when materials are scarce and expensive and when labor is at a premium. On the other hand, the investment-wise farmer is reluctant to spend money for new buildings when materials and labor are abundant because of a depression.

The greatest factor tending to make the farmer conservative and careful in the matter of investing in farm buildings is the fact that buildings represent a large long-term investment. The average life of a barn is about 45 years and the average farmhouse stands about 60 years. Since the average farmer builds one barn and less than one house in a lifetime, he realizes he can not afford to take chances and to experiment. More farm building research is badly needed in order to remove the chance element from this very important expenditure of time, labor, and capital.

Since the farmer does not have at his immediate personal command consulting engineers, purchasing consultants, or research laboratory facilities, he naturally turns to the agencies which our national and state governments have created to perform such services for him. The federal and state agencies previously mentioned were created to perform these functions and are the logical agencies to discover for the farmer the answers to the following and many other questions:

1 What service should the building furnish?
2 How much will the building aid production?
3 How much will it improve the farmer's working conditions?
4 How much will it increase the efficiency of farm operation?

In addition to the above general economic questions, the farmer is asking many specific questions concerning the functional requirements of special types of farm buildings and these questions, also, can be answered only by research. Samples of such specifically directed questions are:

For Housing Livestock:

1 How much space does a dairy cow need?
2 What is the optimum temperature for a dairy cow?
3 What effect does relative humidity have on a cow's health?

For Grain and Food Storage:

1 How much pressure from stored grain must a bin resist?
2 What temperature must be maintained for storing potatoes?
3 How much air movement is needed to dry grain properly?

For the Farm Home:

1 What are the sanitary requirements for healthful living?
2 How much space is needed in the farm kitchen?
3 Where should the workroom for the farmer be located?

For Any Farm Building:

1 What should be the arrangement of floor plans, doors, windows, etc., to reduce time and labor for doing chores?
2 What should be the size of doors, windows, etc.?
3 What wind velocity and snow loads should the building be able to resist?

The answers to these questions and many others will aid the building material producer, the engineer, the architect, the contractor and the building material dealer in supplying the farmer what he needs.

As soon as the necessary additional research has been done to determine the functional requirements of farm structures, industry will be in a position to do further supplemental research leading to adaptation of its products to meeting the farmer's requirements.

If the federal and state agencies already referred to would do the research needed to answer the questions listed above and would broadcast the results through their educational and extension facilities, their work would tend to bring about the following direct results:

1 Simplify the farmer's work.
2 Make the farmer's working hours more productive.
3 Decrease the depreciation of machinery.

(Continued on page 18)

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at Milwaukee, Wis., June, 1944. A joint contribution of the Power and Machinery and the Farm Structures Divisions.

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The Styling of Farm Machinery

By T. H. Koeber

THE magician of industry today seems to be the industrial designer. He pulls rabbits out of the bag, and bang!—you have an unbeatable sales design. At least from some of the advertisements that have appeared of "the postwar this" and "the postwar that", and especially the postwar tractor, there isn't anything to it. Which makes me think of the clipping the vice-president in charge of engineering of our company sent me of a super-duper 194x tractor. His remarks described it well, ending with "It is evidently amphibious also, to be used for moose hunting no doubt."

I seem to be ridiculing my own profession, which is not what I want to do. Back of the advertisements to which I refer is a stimulus and imagination that can be used if properly controlled and correctly applied.

I don't believe there is a harder problem for the industrial designer than the styling of farm equipment. You all know the practical nature of the tractor and allied products and the functional purpose of all the engineering design put into these machines. How to dress that machinery to give it sales appeal and at the same time keep it functional is a tough job, but it can and is being done.

To go back a few years, and that isn't very long ago, we can all remember the cumbersome tractors of that era. Then something happened. The engineers brought out new tractors. They were smaller, more compact, faster and cleaner looking. Unconsciously they were being styled, and the engineers recognized this fact. Some manufacturers tried to do their own styling, others hired industrial designers to do it for them. It was the beginning of "streamlining" for the farm equipment business.

Just how or why styling of the tractor became necessary is debatable but not important. No doubt the great influence of the movies, the automobile and the mail-order catalog caused this. The farmer unconsciously was affected in his buying habits, especially the younger generation, by these influential mediums. The farmer's kitchen stove, his washing machine, hot water heater, automobile, cream separator and innumerable other articles had new clothes on, and it was only natural that the farm tractor came to be next in line. Sales demanded it and sales reflected this new trend in farm equipment.

Just how far the styling of farm equipment can be carried is governed by various factors. Farm machines have limitations because of their functional requirements and the cost element. Those two reasons alone are why I said previously that the styling of farm machinery is tough or hard to justify. While I think it necessary to pay something for styling, function and costs must not be forgotten, and no doubt will always influence the styling of your product, but just how far can you go with it? I also maintain that costs justify themselves in the well-styled product by increasing sales. And styling does increase sales — that has been proven. Another factor to consider is production. A small production volume of a certain item per year may not justify styling, although here again I have seen small sales increased by dressing up the product.

Some farm machinery just can't be styled. Sales or production doesn't justify it, maybe because of the nature of the beast. However, I do believe you can take that particular item and clean it up. Perhaps one piece can be made to take the place of two, castings can be smoothed out, the bumps taken off — that doesn't cost anything. It really is surprising how you can style a product just by this cleaning-up process, and the surprising thing is the engineer can really do a better job in this respect than the stylist. No doubt you all have *one* gosh awful looking product around. Well, just think of it in terms of cleaning it up, not styling but eliminating excessive angle braces, putting a radius where you had a sharp corner and especially smoothing out the castings. You will all be astonished at the results, and, I'm willing to say, without increasing costs, and your manufacturing and assembly departments will like it better also.

What I have just said in a way answers just how far styling can be carried, but other considerations must be given to the question, "Should I style this product, and how far can I carry this styling?" I have already mentioned costs and production and function as practical reasons affecting styling, so now I'll talk about the aesthetic side of designing, for after all that is what I am interested in primarily.

Is it necessary to have an artist—for your industrial designer is an artist—called in to style this product? I would naturally say, yes, do so, unless you already have one on your staff. He can tell immediately if the item lends itself to styling, and is trained to dress up your product much better than the engineer. However, your stylist must work in close cooperation with the engineering department. Costs should be considered to a certain extent, but not too much at the beginning, as you may kill a very good design. The artist must consider the function of the product — it seems I can't get rid of that word — because if he doesn't, his design might as well be thrown out, even if it is a pretty picture. Beware of the freakish design also. By that I mean the superblooper chrome-plated gilded lily. It will cost too much, generally isn't practical, and invariably is only a pretty air brush drawing. In other words, your product to be designed must be practical, of somewhat conservative design, and you must make your stylist realize this.

Another very important consideration to the designing of your product is the material it is to be made of. We have all read and heard about what plastics are going to be like, of resin-bonded plywood and how it is going to take the place of sheet metal. All well and good for certain products, but not for farm machinery. Take plastics, they have very definite limitations. One type is satisfactory

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at Milwaukee, Wis., June, 1944, as a contribution of the Power and Machinery Division.

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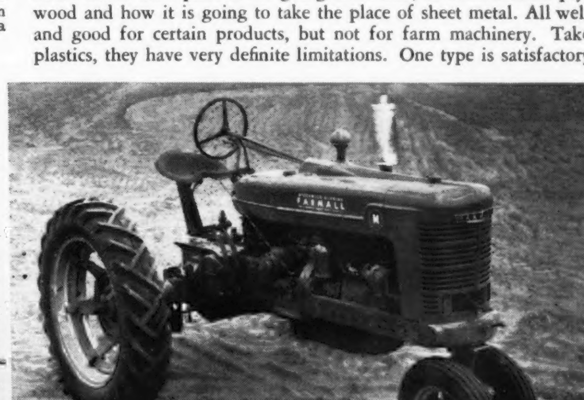
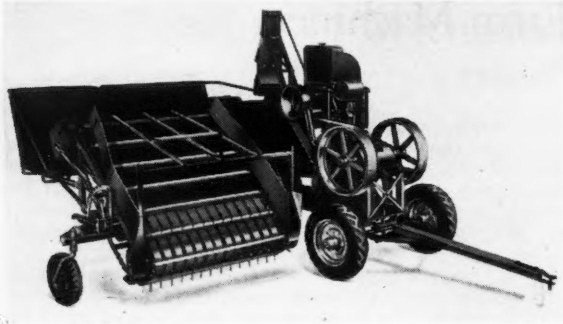
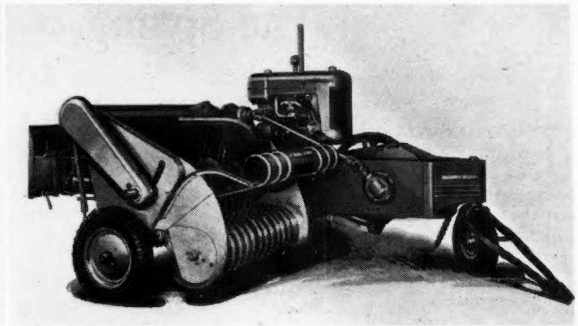


(Left) The F-30 Farmall tractor before redesigning (Right) The same tractor after styling and now known as the Farmall M



The Model 15 McCormick-Deering hay press before redesigning



Redesigning and styling produced this Model 50-T automatic hay press

for extreme cold temperatures, another for hot temperatures, and in the extremes of climate that tractors work in, as an example, hardly satisfactory. Perhaps you have seen pictures of an all-plastic, transparent lucite tractor cab. Well, I don't think anyone would want to sit in a slow-moving tractor all day long, cooped up in a cab like that, and the temperature 100 degrees in the shade. That's what I mean by the stylist being practical and recognizing the limitations of materials. Another important thing about plastics, and again I refer to this picture of a tractor cab, is the curved windshield. The minimum curve without optical distortion is a 60-in radius, not much curve especially in a cab. Not only that, but just picture what will happen to that windshield in a dust storm, for plastics have very poor abrasive-resistance values. What I have said about plastics refers only to decorative uses on your products. They do have uses, lots of them, and in lots of products, but plastics do have limitations.

As to resin-bonded plywood replacing sheet metal, I have my doubts. Even if compound curves could be molded readily, and even if it is lighter than sheet metal, the curing time compared with stamping out sheet metal parts would be prohibitive. Plywood can be as strong as sheet metal, but to equal 16-gauge metal it would have to be 3/8 in thick. Pretty heavy! So materials do have limitations and your stylist must be conscious of this and take it into consideration when he designs your product. I do not wish to convey the impression these materials do not have uses, for they do, plenty of them, especially plastics, and I have used plastics in my designing continuously, but I only wish to impress you with the fact that they do have very definite limitations.

I have been talking mostly of styling in terms of tractor appearance. However, don't forget other products. Some of them lend themselves very easily to improvement in appearance, and it also stimulates the engineering department to improve upon the mechanical design of the particular product. You must remember your stylist looks at things differently than your engineer, and it is highly important that the engineer work with the artist to help him create his idea. Cooperation is very important, and it is very necessary that the engineering department go along with the stylist as well as the other way around. So don't forget your other products — some of them have good design possibilities.

I'll just make a few remarks about the procedure necessary to arrive at a given design. Your designer will present at least a half dozen comprehensive sketches of various designs on a tractor, for example. The management and others interested view these and decide they like design number one, we'll say. The next step will be to lay out this design with the cooperation of the engineering department, when the practical nature of the design will be considered. This done and the layout completed, the next step, and a very important one, is the wood mock-up model, full size. Every important detail should be put on this model, for when it is completed you will have a three dimensional full-size wood tractor to change as you see fit, or improve upon before starting the preproduction model. It saves time and money in the long run. The above procedure, very briefly told, should be carried out and is quite necessary to arrive at a successful design.

Some of you perhaps would like me to make a prophecy as to what the postwar tractor or combine or other product will look like. I don't think I'll attempt to, other than to say that the tractors will not look like some of those we have seen in recent advertisements but will be along the lines of what I have just been talking about. Simplicity of design, clean-cut appearance and consideration of function are the main points to remember.

Mechanization and Farm Structures

(Continued from page 16)

4 Decrease crop loss due to improper storage and handling.
5 Increase efficiency of livestock production.

Such research and education would also tend to bring about the following indirect results:

1 Increase the value of farms because of better buildings.
2 Aid industry to serve better the farmer's building requirements.
3 Increase farm profits.
4 Raise the farmer's standard of living.
5 Improve the farmer's working conditions.

According to a report prepared by the USDA Bureau of Agricultural Economics, 27 per cent of the average farmer's time is spent in and around his farm buildings. This report further states that 80 per cent of a dairyman's time which is devoted to producing and handling milk is spent in and around his buildings. It is obvious that the working conditions afforded by these buildings must be desirable.

If the farmer has too few buildings, his efficiency is impaired. If he has too many, his capital investment is too great. If he has improper buildings, this represents a large misdirected investment. The FHA has done much in specifying functional requirements of the city home. Some of these requirements can be adapted to the farm home. Those requirements which can not be so adapted can be specified by the U. S. Department of Agriculture and the state agricultural colleges and experiment stations.

It has been estimated that it would take 20 billion dollars in the next ten years to rehabilitate our farm buildings to a state of efficient operation. This would furnish employment for an estimated 900,000 men to produce the materials, distribute them, and construct the buildings. Two billion dollars per year looks like a huge sum, but it represents only about $333 per farm per year for new construction, maintenance, and repair. These figures are very conservative.

In the past seven years, it has been my good fortune to attend nearly all the meetings of the American Society of Agricultural Engineers. I have heard the industry group, the college group, and the USDA group dwell at length on the necessity of cooperation between these engineers in developing the proper kind of farm structures. I believe that more complete information on the functional requirements of farm buildings should be attained by a research program carried out by federal and state agencies. A well-coordinated and cooperative program by already existent agencies would be one of the best means of securing quick cooperation of the three groups. I believe it is in the field of basic research that we can have a common meeting ground because research is so vital to us all.

When the farmer begins to remodel and to replace his present farm buildings, those of us in industry, the U. S. Department of Agriculture, and state agricultural colleges and experiment stations will be asked many questions about farm buildings. I hope we will be ready with answers which will aid in bringing structures into their proper relationship with farm machinery.

Resistance of Ear Corn to Air Flow

By Claude K. Shedd
FELLOW A.S.A.E.

INFORMATION as to the resistance of grains to air flow is fundamental in the design of devices or structures for drying the grain by aeration. Small grains usually can be threshed when the moisture content is low enough to permit safe storage in tight bins. Drying after threshing is required only under adverse conditions. Corn, on the other hand, nearly always requires further drying after it is harvested.

The resistance of wheat to air flow was tested by Kelly[1] and the resistance of shelled corn, soybeans, and oats by Henderson[2]. It was found, with these grains, that satisfactory data could be obtained by testing in miniature size bins.

In testing ear corn it was considered essential to use a bin of nearly full scale size. On account of bridging, ear corn is known to settle to more compact mass in a large bin than in a small one. Another consideration was that the interstices between ears at the wall would be somewhat different than in the interior and the effect, if any, on air flow would be difficult to measure accurately.

Equipment Used. The bin used in these tests at Ames, Iowa, was about 7 ft square and high enough to permit testing a 12-ft depth of corn. The floor was of plywood placed over joists and the walls of plywood placed inside of studding. Plywood joints were caulked to make the structure practically airtight. The corn was supported on an open floor made of 1x4-in boards spaced ¾ in apart, the top of which was 2 ft above the plywood floor. Air was forced into the space under the open floor and moved upward through the corn. Air was admitted through a box the full width of the bin provided with a baffle for checking air velocity and distributing air flow uniformly. Fig. 1 is a plan showing the arrangement of bin, fan, and connecting pipe. Fig. 2 is a vertical section of the bin and air entrance box.

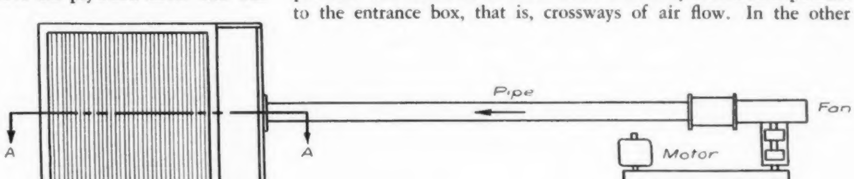


Fig. 1 (Above) Plan of ear corn test bin, fan, and connecting pipe

Air was supplied by a multiblade centrifugal fan driven by a 7½-hp electric motor.

Two lots of corn were tested. Lot 1 contained husks, silks, and shelled corn as harvested by a mechanical picker; lot 2 was clean ear corn.

The different rates of air flow used were 10, 20, 30, 40, 50, 60 and 70 cfm (cubic feet per minute) per square foot of bin floor. Depths of corn from 2 to 8 ft were used in testing lot 1 and depths of 2 to 12 ft in testing lot 2. The pressure drop in passing through the corn varied from 0.002 to 2.66 in head of water, corresponding to velocity pressures developed by winds of from 2 to 74 miles per hour.

Instruments and Accuracy of Measurements. The rate of air flow was measured by a Pitot tube placed in the pipe between the fan and the bin. Three different sizes of pipe (6, 10 and 12-in) were used for different rates of flow in order to keep air velocities within a range that could be measured with sufficient accuracy by use of the Pitot tube.

The impact and static pressures from the Pitot tube were measured by a double inclined-tube water manometer (Fig. 3) which could be read to 0.01-in head with probable error estimated not to exceed ±0.01 in.

The accuracy of Pitot tube measurements of air flow depends largely upon elimination of turbulence. Rowse (Trans. A.S.M.E., vol. 35) found Pitot tube measurements of air flow to be accurate within one per cent, the Pitot tube location being at least 20 to 38 pipe diameters from the last preceding bend or irregularity in the pipe. Moss (Trans. A.S.M.E., vol. 38) recommended that "the tube should be preceded by 10 to 20 diameters of straight pipe and succeeded by about 5 diameters." The pipe lengths used in these tests were shorter than those used by Rowse but sufficient to comply with the Moss recommendation. When velocities as determined by traverses were plotted, they made nearly regular patterns, indicating good uniformity of flow. The probable error in these measurements of air flow cannot be estimated precisely, but ±3 per cent would seem to be sufficient allowance.

Static pressures were measured under the open floor which supported the corn and at various distances above this floor. Pressures under the floor were taken through a ¼-in steel pipe which had the end plugged and two 3/32-in holes drilled in the pipe wall 3 in from the end. Pressure distribution under the floor was taken by inserting this pipe parallel to air flow to various positions. The pressure was found in all cases to be uniformly distributed parallel to the entrance box, that is, crossways of air flow. In the other

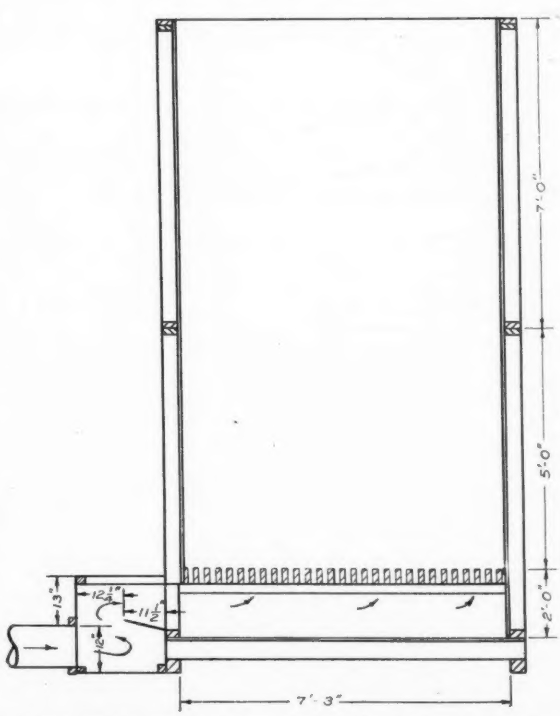


Fig. 2 Vertical section (on AA) of test bin and air entrance box

This paper was prepared expressly for AGRICULTURAL ENGINEERING. Journal Paper No. J-1230, Project No. 587, Iowa Agricultural Experiment Station. (A grain storage project of the Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture, in cooperation with the Iowa station.)

CLAUDE K. SHEDD is agricultural engineer, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture.

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direction, that is parallel to air flow, the pressure distribution was uniform within 1 per cent at low rates of air flow, but at higher rates the pressure was, in some cases, up to 8 per cent less at the entrance side than at the opposite side of the bin. After making a determination of the pressure distribution under the floor in each test, the test run was made with the pipe inserted to a position under about the center of the bin where average pressure was registered.

Pressures at positions above the floor were taken through ¼-in steel pipes extending across the bin and embedded in the corn. Each pipe had the end plugged and 3/32-in holes drilled in the sides of the pipe at 1-ft intervals.

Static pressures were measured with two different instruments. The first was a float gauge which measured pressures up to 0.650 in and which could be read to 0.001-in head of water with probable error estimated not to exceed ±2 per cent ±0.001 in. The other instrument was a U-tube water manometer which was used for pressures above 0.65 in. It was read with a vernier to 0.01 in with probable error estimated not to exceed ±0.02 in.

Description of Corn. Corn lot 1, which contained husks, silks, and shelled corn as harvested by a mechanical picker, was medium to small ears and contained about 20 per cent moisture. A representative sample weighed 0.33 lb per ear. The percentages of foreign materials are recorded in Fig. 4. In placing this corn in the bin, husks attached to ears were left attached. A thin layer of corn was placed in the bin and then proportionate amounts of shelled corn, husks, and silks were uniformly distributed over the corn. This was repeated until the bin was filled to a depth of 8 ft. Tests were made taking static pressures under the open floor and 2, 4, and 6 ft above it.

Lot 2 was clean ear corn, medium size to small ears, and contained 14 to 18 per cent moisture. A representative sample weighed 0.36 lb per ear. The bin was filled to 8 ft depth and a set of tests made taking static pressures under and 2, 4, and 6 ft above the open floor. More corn was then added to 12 ft depth, and another set of tests made taking static pressures under and 2, 4, 6 and 8 ft above the open floor.

Results of Tests. Data obtained in these tests are recorded in Table 1. They are also plotted in Fig. 4 in logarithmic scale using quantity of air flow in cfm per square foot of floor as ordinates and pressure drop in passing through the corn, expressed in inches head of water as abscissas. The points for a given lot and depth lie close to a straight line, indicating a flow formula of the form

$$Q = aP^b$$

in which

Q = quantity of air flow in cfm per square foot of bin floor
P = pressure drop in inches of water.

From data in Table 1, numerical values of the constants a and b in the above formula were calculated for each lot and each depth of corn. These formulas will be found on Fig. 4.

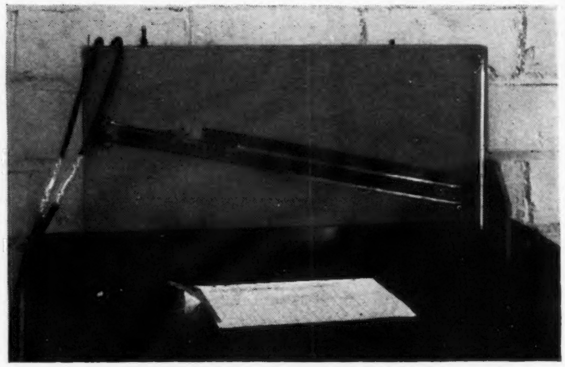

Fig. 3 The double inclined-tube water manometer used to measure impact and static pressures from the Pitot tube

Approximate formulas were also calculated for each lot as follows:

$$\text{Lot 1, 4 to 8 ft depth} — Q = 150\,\frac{P^{0.564}}{D^{0.646}}$$

$$\text{Lot 2, 4 to 12 ft depth} — Q = 303\,\frac{P^{0.442}D^{0.056}}{D^{0.540}}$$

$$\text{or roughly, } Q = 300\sqrt{\frac{P}{D}}$$

D = depth of corn in feet

Discussion of Results. It is shown that, for the same pressure, air movement varied inversely as the square root of depth of clean ear corn (approximately), from which it would be expected that air movement through a crib of corn due to wind pressure would vary inversely as the square root of width. For example, increasing the width of crib 25 per cent from 8 to 10 ft would be expected to reduce air flow about 11 per cent.

Perhaps the most important result of this investigation is the information obtained showing how greatly air flow is restricted by husks, silks, and shelled corn mixed with the ears in proportions that are not uncommon in farm practice. Comparison of the results obtained in testing the two lots of corn can be made from Fig. 4 as explained by the following examples:

Following the horizontal line of 10 cfm air flow, it is found that the pressure required to force this rate of flow through 8 ft depth of clean ear corn is 0.010 in, while to force the same rate of flow through 8 ft depth of the corn *(Continued on page 23)*

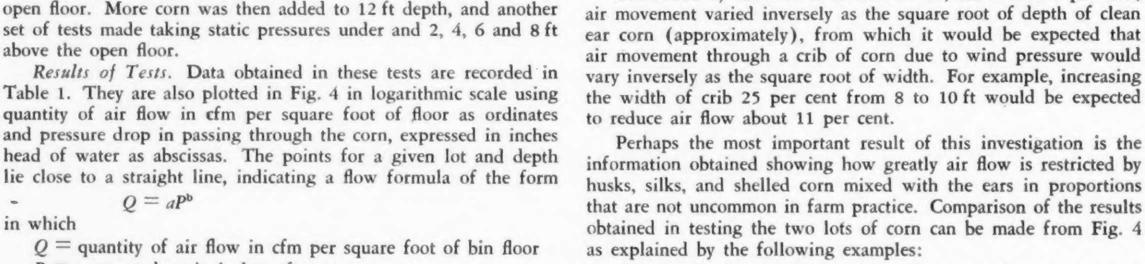

Fig. 4 Data obtained in tests of resistance of ear corn to air flow plotted in logarithmic scale

The Dynamic Properties of Soils

IX. Soil Porosity Determinations with the Air Pressure Pycnometer as Compared with the Tension Method

By F. A. Kummer and A. W. Cooper

MEMBER A.S.A.E. JUNIOR MEMBER A.S.A.E.

THE structure or physical condition of a soil determines to a large extent its suitability as an environment for plants. Among the physical soil properties, dependent upon structure, porosity occupies a key position because the amount and distribution of water and air depend largely upon the size and distribution of the soil pores. It is apparent, therefore, that accurate methods of measuring soil porosity are of fundamental importance in soil physical research. Numerous methods of measuring porosity, either directly or indirectly, have been developed[1, 2, 3, 4, 6, 7*]. The most widely adapted procedure for determining soil porosity in this country is the method developed by Leamer and Shaw[3] for measuring non-capillary porosity by removing water from a saturated soil sample under a given tension. This procedure has been selected as a basis for comparison with the method described in this paper which is an application of Boyle's Law of pressure—volume relationships. Similar adaptations of this principle have been reported by Torstensson and Eriksson[6], Visser[7], and Nitzsch[4].

Principle of Operation of the Air Pressure Pycnometer. To illustrate the principle upon which the operation of the apparatus (Fig. 1) is based, the following analogy is used: The apparatus consists essentially of two major parts which may be compared to the two vessels, A and B, connected through a valve, E, as shown in the simple diagram (Fig. 2).

Vessel A may be compared with the compression chamber A, including the air tube extending to valve E. Vessel B represents the part of the apparatus between valves E and I, including manometer C, mercury well J, and air volume chamber G. When valve E is closed, the pressure and volume of the air in vessel A are P_1 and V_1 respectively, and for vessel B are P_2 and V_2. When valve E is opened, pressures P_1 and P_2 equalize, and the resulting pressures and volumes are P_3 and V_1 for vessel A, and P_3 and V_2 for vessel B.

Thus $P_1V_1+P_2V_2=P_3V_1+P_3V_2$

$$\text{or } P_3=\frac{P_1V_1+P_2V_2}{V_1+V_2}$$

Since P_1, P_2, and V_2 are kept constant, the value of V_1 may be determined if P_3 is known. P_3, however, is established from the position of the mercury on the manometer scale after the pressures are equalized. If the mercury level in the manometer is set on the zero mark when V_1 is equal to the volume of vessel A, then V_1=-P_3=0. Any decrease in V_1 caused by the insertion of a soil sample in A, will effect an increase in P_3, which causes a rise of the mercury level on the manometer scale. This scale may be calibrated to read volume changes directly, or it may be a millimeter scale from which readings of manometer differences are taken and converted to the corresponding volume by the use of a conversion table or chart.

Description of the Apparatus. The apparatus as shown in Fig. 1 represents the construction of the air pressure pycnometer. Valve K permits the entrance of compressed air into the system. The source of compressed air may be either from a cylinder or directly from the compressor through a suitable pressure regulator. Air is admitted into the system until the mercury in the capillary tube of the manometer C reaches the enlargement at the top of the tube. The mercury well J at the foot of the manometer receives current from a 6-v cell or a transformer F. A platinum electrode is inserted in the top of the manometer tube in such a manner that the electrical circuit is closed when the mercury column reaches a predetermined height. A small lamp B, included in this circuit, is lighted when the mercury column makes contact with the platinum electrode. Thus, a constant height of the mercury column can easily be maintained. The equalizer bellows H provide a still finer adjustment of the air pressure on the mercury column and a more sensitive contact between the mercury and the platinum electrode when valve K is closed. Thus, it is possible to maintain a definite volume of air under a definite pressure in the apparatus. The air volume chamber G provides sufficient air in the system so that the manometer C can be equipped with a scale of suitable range. When the system is filled with air under a predetermined pressure (approximately 10 psi), valve K and valve I are closed. Valve E is then opened and the manometer and air volume chamber are connected to the compression chamber A by means of copper tubing. Valve I must be closed during this operation, because the air volume in the equalizer bellows is changed by each adjustment of the mercury column. When valve E is opened, the atmospheric pressure P_1 in the compression chamber and the excess pressure P_2 in the apparatus equalize and the mercury drops to a certain point on the adjustable scale D corresponding to pressure P_3. The position of the mercury column on the scale is in direct relation to the volume occupied by the soil sample in the compression chamber. Therefore, any change in volume of the soil sample will be reflected by a corresponding change in the position of the mercury column on the manometer scale. It should be pointed out here that the readings obtained by this method represent the volume of the soil substance and the volume of water contained in the sample.

The use of the apparatus, as described

Ninth of a series of articles, published exclusively in AGRICULTURAL ENGINEERING, setting forth the results of research work in soil dynamics at the Alabama Polytechnic Institute in cooperation with the research division of the Soil Conservation Service, U. S. Department of Agriculture. Released for publication with permission of the Director, Alabama Agricultural Experiment Station and the Chief of Research, Soil Conservation Service.

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*Superscript numbers denote the references appended to this paper.

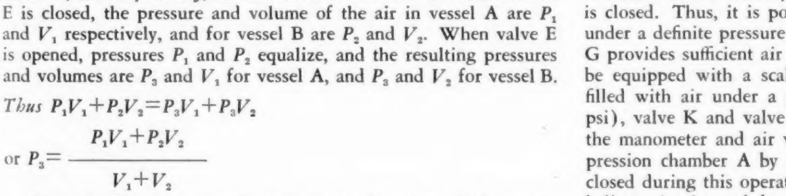

Fig. 1 This drawing shows the construction of the air pressure pycnometer. A, compression chamber; B, light bulb; C, manometer; D, adjustable scale; E, stop and drain cock; F, 6-v battery or transformer; G, air volume chamber; H. equalizer bellows; I, stopcock; J, mercury well; K, stopcock; L, compressed air supply

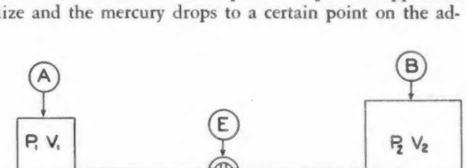

Fig. 2 This drawing illustrates the basic principle on which the air pressure pycnometer operates

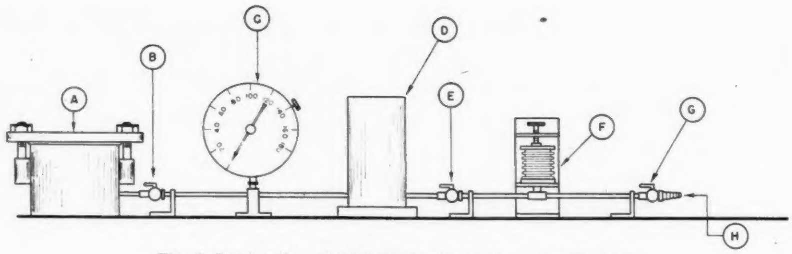

Fig. 3 Construction of field model of air pressure pycnometer

above, is limited largely to laboratory work because of its fragility. A more rugged construction is suggested where it is desirable to transport it or use it in the field. The construction of this apparatus is shown in Fig. 3 where a pressure gage is substituted for the mercury well and manometer tube. The pressure gage should have a dial of sufficient diameter to permit a calibration of approximately 200 divisions in 180-deg deflection of the indicator needle. Another alternative might be the use of a sensitive diaphragm, connected to a scale of suitable range, in place of the pressure gage. The advantage of this device would be that it could be transported without danger of breakage and could be used in the field with a pressure tank as air supply. No other changes in design are necessary. Care should be exercised to make all joints of the copper tubing in the system air-tight by means of solder joints. The use of rubber tubing in place of soldered copper tubing has not been satisfactory because of the difficulty of keeping the system sealed under pressure.

Calibration of the Apparatus. Before actual volumetric readings of soil samples can be made with this apparatus, it is necessary to calibrate the instrument. An adjustable scale (preferably a millimeter scale) is placed behind the manometer tube in such a manner that the height of the mercury column may be determined after the pressure in the system has equalized. A cylindrical container, having the same total volume as the soil sample cylinder, is placed in the compression chamber and weighed increments of water are added. For each increment of water, a reading is made on the manometer scale and recorded. When all increments from zero to full volume have been recorded, a calibration curve may be plotted with increment volumes as abscissas and manometer readings as ordinates. Thus a scale can be established from which any increment volume of the cylinder may be read directly. All soil sample cylinders should contain the same volume as the calibration cylinder. If variations in volume exist, proper corrections must be made for the differences.

The daily adjustment of the apparatus with respect to barometric pressure and temperature changes may be made as follows: The cylindrical container used in the original calibration of the apparatus is filled with a known quantity of water and its volume is determined in the air pressure pycnometer. If the scale reading varies from the calibration reading, the adjustable scale must be moved up or down so that the reading coincides with the original calibration value. For routine test work, it may be advisable to construct a solid test piece of known volume which can be inserted in the compression chamber to check the manometer scale at any time.

DISCUSSION

The values listed in Tables 1 to 4 were based on measurements made with the air pressure pycnometer and by the weight difference method described by Leamer and Shaw[3]. The soil sample cylinders had an outside diameter of 5 in, a height of 3 in, and a total measured volume of 910 cu cm. All samples were taken from the surface layers of field soils, in their natural condition, with a soil sampler similar to that described by Yoder[8]. In order to compare the two methods, the soil samples were saturated in the prescribed manner and weighed. The saturated weights are given in Table 1, column 2. The volumes of soil and water in the saturated samples are given in Table 3, column 2. The weights of the samples after 60 cm tension was applied are shown in Table 1, column 3, and the corresponding volumes in Table 2, column 2. The values for non-capillary porosity were determined for the two methods and are shown in Table 1, column 5, and Table 2, column 4. In order to explain the considerable differences in non-capillary porosity values obtained by the two methods, it was necessary to consider the lack of saturation of the samples. When the differences between the saturated volumes and the total volumes of the samples (Table 3, column 3) were added to the differences in weights of the saturated samples and the samples at 60 cm tension (Table 1, column 4), the non-capillary porosities corrected in this manner (Table 3, column 5), approached very closely those obtained with the air pressure pycnometer (Table 2, column 4). The lack of saturation shown in Table 3, column 3, is within the range of water — unsaturation of natural soils as reported by Smith and Browning[5]. However, on the basis of preliminary investigations, the authors believe that the lack of saturation is not due entirely to a concentration of air as bubbles in the intermediate pore sizes. It is realized that further proof is necessary and a probable approach to the solution of this problem may be the adaptation of a high-pressure air pycnometer. This would permit tests with successively higher pressures for volume determinations of saturated samples.

The principal advantage of the air pressure pycnometer over the weight difference method is the speed with which the measurements can be made. A single determination of the volume of soil and water in a given soil sample, at any moisture content, may be made in less than 2 min. The volume occupied by air in the sample may then be determined by merely subtracting this volume from the total volume of the soil sample cylinder. It is not necessary to saturate the sample, nor need measurements be confined to any particular moisture content. Thus it is possible to determine the pore space volume of a soil sample at the prevailing field moisture immediately after it has been brought to the laboratory. In order to correlate the results, it is only necessary to base all values for a given soil on a standard or average moisture content. Aside from the fact that the difficulty of saturating the soil samples is eliminated, the probability of erroneous results appears to be greatly reduced. For example, if the values of non-capillary pore space for samples No. 2 and No. 3 in Table 1, column 5, are compared, it will be found that sample No. 2 shows a higher percentage of non-capillary pore space than sample No. 3. These same two samples, however, were found to be in inverse proportion when measured with the air pressure pycnometer. This error was caused by the different degrees of saturation obtained for the two samples. By examining Table 3,

TABLE 1. NON-CAPILLARY POROSITY OBTAINED BY LEAMER AND SHAW METHOD

	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5
Sample No.	Total volume of soil sample cu cm	Weight of soil sample saturated, g	Weight of soil sample after applying 60 cm tension, g	Difference in weight col. 2 - col. 3	Non-capillary porosity, col.4 ÷col. 1x100
1	910	1752	1686	66	7.3
2	910	1801	1755	46	5.1
3	910	1708	1676	32	3.5

TABLE 2. NON-CAPILLARY POROSITY OBTAINED WITH AIR PRESSURE PYCNOMETER

	Col. 1	Col. 2	Col. 3	Col. 4
Sample No.	Total volume of soil sample, cu cm	Volume of soil and water after applying 60 cm tension, cu cm	Difference between total volume and volume after 60 cm tension col. 1 - col. 2, cu cm	Non-capillary porosity, col.3- ÷col. 1x100, per cent
1	910	779	131	14.4
2	910	818	92	10.1
3	910	779	131	14.4

TABLE 3. NON-CAPILLARY POROSITY OBTAINED BY LEAMER AND SHAW METHOD AND CORRECTED FOR LACK OF SATURATION

	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5
Sample No.	Total volume of soil sample, cu cm	Volume of soil saturated measured with air pressure pycnometer, cu cm	Volume of air space in saturated sample, col. 1 - col. 2 cu cm	Difference in weight (col. 4, Table 1) plus volume of air space in saturated sample (col. 3, Table 3)	Non-capillary porosity col.4÷col. 1x100, per cent
1	910	851	59	125	13.7
2	910	870	40	86	9.5
3	910	807	103	135	14.8

column 2, it will be found that sample No. 2 had a saturated volume of 870 cu cm, whereas sample No. 3 only had a saturated volume of 807 cu cm. The difference between the two volumes and the total volume of the cylinder accounts for the reversal of the pore space values determined by the two methods. Other examples may be found by comparing the data in Table 4, columns 1 and 2.

TABLE 4. COMPARISONS OF NON-CAPILLARY POROSITY VALUES OBTAINED WITH LEAMER AND SHAW METHOD, AIR PRESSURE PYCNOMETER METHOD, AND LEAMER AND SHAW METHOD CORRECTED FOR LACK OF SATURATION

Sample No.	Col. 1 N.C.P. Leamer & Shaw per cent	Col. 2 N.C.P. Air pycnometer, per cent	Col. 3 N.C.P. Leamer & Shaw (corrected), per cent
1	8.7	15.7	15.2
2	7.3	14.4	13.7
3	5.1	10.1	9.5
4	7.8	19.0	19.7
5	3.5	14.4	14.8
6	5.2	12.5	11.7
7	3.7	7.7	7.3
8	8.5	14.8	13.8
9	10.5	13.6	12.3
10	12.2	15.5	16.0
11	10.2	15.2	15.3
12	11.5	14.8	15.5
13	10.7	15.9	15.7
14	12.3	16.5	15.7
15	7.5	11.2	12.5
16	14.5	19.0	19.1
17	7.6	11.3	11.4
18	6.9	11.6	9.8
19	15.5	23.0	20.7
20	7.8	12.0	11.5
21	18.2	27.8	25.4
22	6.2	10.8	9.2
23	15.4	24.6	23.0
24	2.4	3.4	2.4
25	1.5	3.6	4.5
26	8.0	8.7	8.9
27	8.9	17.0	15.4
28	7.5	15.7	15.7
29	7.6	13.6	12.2
30	8.5	15.7	14.4
31	10.1	12.5	11.1
32	10.2	18.4	17.7
33	10,6	18.4	16.7
34	5.1	12.1	11.8
35	5.0	12.5	12.0
36	5.5	11.7	10.1

Additional Applications of the Air Pressure Pycnometer. It appears at the present time that this apparatus may have additional uses for determining other soil physical properties. Preliminary investigations indicate that the apparatus can be used for determinations of the specific gravity of soils or, if the specific gravity of the soil is known, for determining the water content of the soil as pointed out by Torstensson and Eriksson[6].

The total porosity of soils can be obtained by drying the sample and measuring the volume of the soil substance. This volume subtracted from the total volume of the sample cylinder will be the total pore space. It is believed possible that the apparatus can be adapted to measure porosity and moisture content in soil clods of irregular shapes. Analysis of these data and further developments of the apparatus may also furnish valuable information on questions concerning shrinkage and swelling of clay soils.

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AUTHORS' NOTE: Acknowledgment is made to M. L. Nichols, H. E. Middleton and R. E. Uhland for their constructive criticisms and valuable suggestions made in connection with the preparation of this paper.

Resistance of Ear Corn to Air Flow

(Continued from page 20)

containing foreign material, the pressure required is nearly nine times as much, 0.088 in.

Another comparison can be made by following a vertical line of equal air pressures. For example, with pressure of 0.25 in, the rate of flow through 8 ft depth of the corn containing foreign material is 18 cfm, and through the same depth of clean ear corn, 49 cfm, or 2.7 times as much.

Based on data obtained in these tests, air flow per square foot of section would be about the same in a crib 12 ft wide filled with clean ear corn as in a crib 2 ft wide filled with corn containing usual amounts of foreign material. Air flow per bushel of corn would be about the same in a crib 12 ft wide filled with clean ear corn as in a crib 6 ft wide filled with corn containing usual amounts of foreign material.

TABLE 1. TESTS OF RESISTANCE OF EAR CORN TO AIR FLOW

Date of test	Corn lot no.	Depth of corn in bin, ft	Quantity of air, cfm, per sq ft of floor	Static pressure, inches of water column: Under floor	2 ft above floor	4 ft above floor	6 ft above floor	8 ft above floor
Apr. 25	1	8	10.0	0.091	0.069	0.043	0.022	
25			20.6	0.299	0.228	0.142	0.068	
26			30.4	0.602	0.456	0.284	0.138	
27			41.1	1.06	0.82	0.484	0.227	
27			48.9	1.42	1.08	0.637	0.304	
29			60.6	2.17	1.65	1.02	0.463	
29			69.8	2.66	2.02	1.27	0.583	
May 11	2	8	70.6	0.515	0.360	0.230	0.112	
11			61.3	0.396	0.272	0.176	0.084	
12			49.4	0.272	0.186	0.119	0.057	
12			39.5	0.176	0.123	0.077	0.037	
13			30.4	0.101	0.069	0.043	0.018	
16			20.8	0.045	0.030	0.019	0.0075	
16			10.5	0.0105	0.007	0.0045	0.001	
24	2	12	10.2	0.019	0.014	0.0095	0.006	0.004
24			20.3	0.067	0.052	0.041	0.028	0.015
25			29.9	0.153	0.121	0.093	0.067	0.041
25			39.9	0.262	0.207	0.159	0.114	0.067
26			49.1	0.396	0.311	0.238	0.171	0.104
26			60.0	0.595	0.467	0.361	0.257	0.157
27			72.5	0.83	0.65	0.502	0.358	0.218
June 14			72.5	0.84	0.66	0.504	0.362	0.222

These results indicate that cleanness of husking and elimination of shelled corn and fine materials from corn going into the crib are factors of primary importance in storing corn containing a high percentage of moisture which requires good aeration to prevent heat and mold damage.

"A Firesafe, Labor-Saving Livestock Compound"

TO THE EDITOR:

THE article by E. L. Hansen in the November AGRICULTURAL ENGINEERING was particularly interesting to me. The structure described certainly has a number of advantages over present and past livestock shelters. It reminds me of a building described some years ago by Wm. Boss of Minnesota, a past-president of A.S.A.E., who knitted his units still more closely by designing a structure many stories in height in order to reduce the floor area.

Mr. Hansen's compound is more practical, however, and while it may have features not entirely satisfactory, it certainly offers advantages to the diversified farmer. Features appearing especially favorable are lower cost, firesafe construction, smaller farmstead area, reduction in floor and wall areas, heating economy, and work simplification.

There may be some objection to the absence of windows. In warm climates where summer heat is just as serious as winter cold, ample ventilation is imperative and is aided by window openings. Gravity ventilation may be adequate without requiring electric power. Large window areas will permit a saving in electricity for lighting.

Sanitary regulations may prove the greatest obstacle in the development of this building. Milk cows are too close to other animal units. As Mr. Hansen states, however, they are separated by solid walls or vestibules, just as well as by a distance of 100 ft. When oriented properly with regard to prevailing winds, the objection is largely overcome, and it is possible that sanitary regulations would eventually permit such an arrangement.

I am interested in the reactions of other members of A.S.A.E. to the principles presented in this structure.

L. W. NEUBAUER

Division of Agricultural Engineering
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Door and Window Design to Eliminate Heat Loss in Dairy Barns

By W. C. Krueger
MEMBER A.S.A.E.

FUNCTIONAL planning of farm structures has caught the imagination of agricultural engineers, building material manufacturers and planners throughout the nation. It has prompted inspection of the entire range of building recommendations. At a time therefore when precedent, rule-of-thumb practice, and traditional methods are opened to question, it seems opportune to discuss certain details in barn construction that are often given minor consideration.

When a farmer commits himself to a new barn, for instance, he has available plans and recommendations of his agricultural college, the U. S. Department of Agriculture, the farm equipment industry and the help and advice of his contractor, carpenter, or neighbor. Review in your mind information usually so supplied and you will note the frequent omission of many finer points of construction that are powerful factors in insuring complete satisfaction and service; or recall the dairy barns you have visited the past year.

Otherwise well-planned and soundly constructed buildings lack the finish of detail that spells the difference between just another barn and one that inspires pride of ownership. Doors and windows are among the items so neglected. Rotted and paint-peeled window sills and frames are common, putty has broken away, glass is held only by nails and surrounded by cracks. You see steel sash rust encrusted, bent and twisted by attempts to open frost-frozen sash and with glass rattly loose. Window frames in masonry walls particularly have too often pulled away from the wall, leaving side cracks.

Doors do not fare much better. The plank frame barely two inches thick is a poor tie when a heavy hinge is necessary to support the door. Seldom do hinge screws tie into the wall or into wall inserts. Fasteners are usually loose or the door has to be lifted to engage. Then when by persistent force the door is closed, it is open on one to three edges.

Now these things are more than mere aggravation. Heat retention in a barn, particularly in the northern climates, is necessary for the comfort of the workmen and the animals housed. Heat must not be wasted in order that there be enough to permit adequate ventilation without unduly lowering barn temperatures. Insulation of the ceiling or the sidewalls or a combination is not necessarily insurance that the barn will give satisfactory heat and ventilation performance. I do not have figures for windows constructed as in dairy barns, but we are told that in houses, for every foot of window sash perimeter not weatherstripped, as much as 125 cu ft of air per hour passes through this reasonably close fitting construction. How much more can we expect in the case of barn window or door construction?

Ordinary care as to details in window frame planning will insure tight construction. Of first importance is a good frame support. In frame walls, I like to see a double 2x6 for a header and base. In the case of masonry walls, a jamb key should be fitted to the frame and imbedded in the wall, and the window sill and the inside sloping stool set on a soft mortar fill so as to close all joints effectively. A step-construction jamb provides a solid stop for both the window and the storm sash as they are inserted from the inside of the barn. Equally tight construction in frame walls is accomplished by lap construction of the frame members. The window stop for the regular barn window runs to the outside window casing and the storm sash fits within this, the casing lapping the storm sash a good 1/2 in on top and sides. The inside sash butts against this stop in turn. This precludes any possibility of air passing directly through any part of the frame construction. By V-notching the bottom rail of the inside windows to fit the outside edge of the sharply sloping stool, condensation on the inside surface is directed into the barn while rain or other moisture on the outside continues in that direction.

Important to satisfactory window operation are dependable fasteners which will stand the racket of daily use and the buffeting of winds and yet permit of a tension closure.

Doors represent considerable heat leakage, not only through poor fit but air conduction through the relatively thin material. Insulated doors need not be clumsy or crude looking. A door of solid construction and having fair insulation properties can be built by using matched lumber, placed diagonally or vertically, outlining this with a frame and cross members of 6-in board, filling the panel spaces so formed with rigid insulation board and after covering both sides with vapor-resistant paper, finishing the door with sheathing of hard-pressed composition board or thin cement asbestos sheets. This door will be heavy, needs good hinge support, but will stand usage.

Heat conservation is assured through the employment of storm windows and the use of vestibules or a double entry so that cows and carts can be brought in or out of the barn without too great loss of heat. Recommendations are quite definite that insulation and storm fixtures are necessary in Zone 1 and on the north and west sides of barns in Zone 2. Insulation helps maintain temperatures, facilitates ventilation, and prevents damaging condensation on the interior of barn surfaces. It is possible to possess a well-insulated barn and still have very unsatisfactory conditions from the standpoint of dampness, cold and foul air. In looking over nearly 200 survey blanks covering a wide range in dairy barn types in New Jersey, I was amazed to realize how few barns were really satisfactory from the temperature standpoint, how few had any form of controlled ventilation system, how many farmers reported the silo chute and the hay chute as their standard "outtake flues", how many use nothing but windows for intake ventilation control, how many confused hip and gambrel roofs, how many thought that roof ventilators by some legerdemain provided stable ventilation.

Other points of interest were also noted. Some of the most satisfactory barns from the standpoint of dryness and winter warmth were those that were crowded with animals, had no form of ventilation or air exchange other than window and door cracks and the everpresent cat holes. Some barns had stalls two feet and ten inches wide and reported them satisfactory. One enterprising dairyman managed to get three rows of cows in a 30-ft wide barn. Concrete in mangers was often badly pitted and rough; floors were also badly pitted, showing indications of a poor job in the original concrete work.

Among the miscellaneous suggestions which have been made as a result of such surveys and individual barn visits are the following. The fire hazard of hay and straw storage recommends consideration of separate buildings for the animals and their feed. Although no comparative studies have been reported, it is felt that the labor under the two systems will be about the same provided the hay and straw is baled. Where storage is above the animals, self-closing hay chutes and milk house, feed and silage room doors are indicated. Ceiling joists must have fire stops between them at the wall and a layer of fire-resistant material having some insulation value should constitute a part of the mow floor. Vapor-sealing qualities in building papers is the exception rather than the rule; tarred felt, red resin paper, ordinary paint coating and many of the asphalt impregnated fabrics are not sufficiently vapor resistant to be effective as a wall or ceiling seal. The vapor seal should go on the inside surface of the dairy barn and other animal structures and, incidentally, should probably be concentrated on the outside surface of refrigerated storage structures. Conversely, walls of insulated animal structures should be vented towards the outside or cold surface, and refrigerated walls may well be ventilated on the inside surface.

Much experimental work is still needed to determine the amount of heat and moisture emitted by cows according to their size, their lactation period and age; also how much water is evaporated from gutters and from water cups and what the moisture losses are through the walls and ceilings. It is interesting that many dairymen recommend that maternity and calf pen drains be in the nature of scupper holes in the curb toward the feed alley floor drain, not directly in the floor of the pen itself, (Continued on page 26)

This paper was presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at New York City, September, 1944.

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Shall the Farmer Be Encouraged to Continue Doing His Own Construction Work?

By J. L. Strahan
FELLOW A.S.A.E.

AN ANALYSIS of the overall job facing American farmers today might throw considerable light on what the future trends in farm construction are likely to be. American agriculture is going to be called upon to feed and to produce the raw materials for clothing not only for our own population, which is still growing, but also a fairly large proportion of the peoples of other countries. In addition they will furnish much raw material for various industrial processes such as fiber for building materials, grain for alcohol, cellulose for plastics, and seeds for oil. Successful and profitable production of crops and animal products requires an intimate knowledge of underlying horticultural, chemical, and biological sciences and their practical applications. The farmer must therefore be a scientist, as well as a good manager, and, being limited in his operations by the natural phenomena of weather, insect and bacterial pests, to no small degree a philosopher. In view of these already diverse and varied demands upon his resources, should he also undertake to be a builder?

It is true that when this country was settled, when an agriculture adapted to the needs of a pioneer economy was carved out of a wilderness, he had to do many things not basic to agricultural production simply in order to survive. He was obliged to build his own and his livestock's shelter because there was nobody to do it for him. For the same reason he had also to make his cloth for clothing and cobble his own shoes. The custom was so universal and so essential that failure in any of these fields was considered a mark of personal inadequacy, even of laziness. The concept was so strongly held that when labor-saving equipment was first introduced, in a comparatively crude form, its use was considered by some "rugged" individualists to be positively sinful.

Now, however, the country has grown up. It has grown industrially. Specialists have taken over many of the formerly essential tasks and have succeeded in producing clothing, shoes, machinery, and other essential instruments of living, including specialized building materials which are far superior in quality and usefulness to the venerated homemade items. Have the farmers then continued to spin and weave and cobble and tinker? A glance at the mail-order catalogs will provide a quick answer to that question.

No, the concept of self-sufficiency has died out to a very large extent. But in the field of farm construction it dies hard. It seems to me that there is no essential difference between these "lost arts" and the one which I believe is gradually becoming obsolete, namely, homemade building construction on the farm. My reasons are

1 That farmers can no longer afford to do necessary building, even if they have the time.

2 They do not have equipment necessary to do an adequate job.

3 They are not mechanically qualified to get the full benefit from their building investment.

Consider the first point. Buildings were valued in 1925 at 11½ billion dollars. In 1940 they were valued at 11 billion dollars. I do not know how the census figures were derived, but if the methods were the same both times they indicate that there has been about a 5 per cent dollar loss in value in the 15-year period, considering dollars to be constant in value. Dollars depreciated considerably, however, so it is probable that the dollar loss indicates a somewhat greater value loss. That loss must be checked and the values replaced if our farm plant is to serve adequately the stepped-up agricultural production program which is foreseen. In terms of actual case histories we have seen 1000 farms in the northeastern states purchased during 5 years between 1937 and 1942 at figures which by law were required to represent no more than average values in their communities. We have seen these farms studied carefully to develop well-balanced enterprises which could reasonably be expected to liquidate the investment out of income in a reasonable length of time at a modest interest rate. In each case we have seen an engineering study made of the physical plant to determine how best to utilize and adapt it to the new enterprise, or combination of enterprises. And finally we have seen what it actually cost at present prices, largely estimated on the basis of the farmer doing most of the work himself, to perform the necessary and essential construction. The average was $1185.00. That is what it cost to bring the buildings, including the dwelling house, up to reasonable, modest structural and functional standards. Projected from this base to cover all farms in the area it represents needed construction to the extent of $530,725,397.

As stated above, these estimates were figured on the basis of the farmer doing a large share of the work. Just how much and what the value of it is has not to my knowledge been statistically determined. But for the sake of argument let us say that the average contribution of the farmer and his family in unpaid construction labor will be 25 per cent of the total value of the project. If this is fair, and I think it is, then the construction value would average $1580, of which $395 would be the farmer's contribution. What is his comparatively unskilled labor worth? At 30c per hour it would require him to put in 132 hours, or 22 6-hour working days. This will be in addition to the job of rounding up the necessary materials and organizing his carpenter help, which would normally be done by a contractor. Because, of course, he will have to hire some additional help, as it is usually true that the total cost of doing a construction job is divided about half and half between labor and materials. The problem is further complicated by the need for sandwiching the work in between essential farm jobs if done during the time of year when construction can be most easily and economically performed, or by doing it in off seasons when the weather is not so propitious. These figures are for *average* cases. There will be many that are more extensive and some that are less. Considering the load involved in the average case, the larger jobs will call for an amount of managerial attention and labor that will pretty well insure that, for one season at least, little farming will be well done; and this is on the assumption that the construction job is completed expeditiously and with a minimum of waste motion.

Records show that such work is not expeditiously completed. Some of the loans that were made during the fiscal year 1937-38 involve work that is still not completed. A larger proportion of the next year's projects are not yet completed. And still more of the following years' projects. The average length of time to complete the work, considering all cases, was over four years. This is analogous to a farmer's acquiring a tractor by buying the chassis the first year, the motor the next, the wheels next and finally the carburetor, transmission and other essential parts the fourth year, after which he would assemble them into an operating unit. He ultimately gets a tractor, providing he is competent to put it together, but he doesn't use it for four or five years after he decides he needs it. It is extremely doubtful whether his investment will pay him proper dividends under such a procedure. If this is absurd with respect to mechanical equipment, it is equally absurd with respect to service buildings essential to the proper operation of a productive enterprise.

In the Northeast it was estimated that $530,725,397 represented the cash cost of needed construction in 11 states. Based on hiring all necessary mechanical labor, thus freeing the farmer for agricultural production, the cost would be 20 per cent higher than this, or $707,638,863. If the work were contracted the cost would be 10 per cent more, or $778,397,249. The farmer will pay out for this work nearly 531 million dollars anyway. If he hires it done by contract he will pay out about 775 million dollars. By doing it himself he presumably "saves" 248 millions.

But for this 248 million dollars he could buy for himself (1) four years without interruption to his essential farm productive enterprises, (2) the use of his improved facilities for at least 3½ years longer than otherwise, (3) high quality construction with

Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers, at New York City, September, 1944.

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correspondingly reduced depreciation charges, and (4) adequate functional performance throughout the life of the structure, with all that that implies in the effect upon his productive efficiency. Some better statistician than I will have to evaluate these advantages in terms of dollars. My guess is that they will far outweigh the original "saving" in first cost.

I maintain that a farmer doesn't have time to do his construction work; and if he takes time he doesn't have the service from his plant that he needs and that makes his investment a profitable one; in other words, he can't afford it.

Consider now the second point having to do with tools and equipment. How many farmers have a concrete mixer, a bulldozer, scaffolding equipment essential for doing a safe job of roofing, special shears for shaping asbestos coverings, concrete finishing tools, skill saws, spray guns for paint, staplers for applying vapor seals or bat insulation, etc.? Very few. It will be argued no doubt that a concrete mixer can be hired, that a team with a scraper will do the excavation and grading, old scrap lumber can be utilized for scaffolding, asbestos doesn't have to be used, concrete had best be left rough with a wood float, a hand saw is all a practical man needs, paint can be brushed on or better yet not used at all, and vapor seals and insulation can't be afforded anyway, so why bother. My answer is that these time-honored and makeshift methods are hangovers from pioneer days, and that they are perfectly adapted to pioneer conditions. If our agriculture is to remain a pioneer industry I have nothing more to say. If it is not, if it is to grow up and compete for parity with American industry, it must adopt industrial methods, and accept industrial service.

BUILDINGS ARE INDISPENSABLE TO AGRICULTURE

With respect to mechanical equipment it has done this. The ability to produce adequate equipment has been demonstrated beyond question by manufacturers; without their contribution agriculture simply could not have equipment in the modern mechanized sense. With respect to buildings, industry is still a long way from demonstrating that they are indispensable to agriculture. This may be partly because farmers have been able in a hit-or-miss fashion to cobble up out of traditionally cheap and easily worked materials, sufficient housing to afford a minimum of protection. But more importantly I believe it is because housing as it can be, sound in design and functionally adequate, has not been demonstrated either by the building materials industry or the construction industry. The manufacturers have produced good tractors, but the builders have not yet produced good structures. This is an indictment of the building industry and is intended to be. In its own interests it might well recognize an opportunity in this situation and begin to do something constructive about it. It should be able to demonstrate its indispensability to agriculture in the field of structures.

The above digression from the main thread of my argument simply shows that, if farmers are still by and large doing a pioneer job on their farm buildings, it is because they are obliged to. Still they have nobody to do it for them. It is obviously necessary for someone to provide them with the necessary modern tools wielded by competent mechanics who know how to handle newer materials. The building industry as represented by materials dealers and rural contractors should be able to do this.

Now as to my third point. Regardless of the present necessity for farmers doing their own construction work, and regardless of the effort that is expended by public educational agencies to make farm boys mechanically competent through vocational courses, the fact remains that the largest proportion of farmers on the land and in production are not and will not be capable of handling building tools and materials as well as those can who make their living by it. Good carpentry requires an honest apprenticeship. It can't be learned in six easy lessons. The same is true of roofing, painting, plumbing, electric installation. And it is especially true where newer materials like built-up, cold-process asphalt roofing or asbestos-cement products are involved. The "know how" necessary to produce good results comes from experience and practice. Experience cannot be gained by doing just one job and then laying off for 10 or 15 years until the next one comes up to be done. Practice which develops mechanical adequacy means working at it 6 days a week, week after week and year after year. Good mechanics are not born; they are made. And not overnight either. It is no more reasonable to expect a farmer to be a good building mechanic than it is to expect a lawyer, a school teacher, or a clothing retailer to be one. And by inference, it is no more reasonable to criticise the one than the others for not being. There are no doubt many farmers who are excellent mechanics and are qualified to take on a real construction job. But the same can be said of people in other walks of life.

The foregoing arguments are directed against the practice of home construction of farm buildings. In this catagory I class all new construction and all major repair and remodelling work. For ordinary maintenance and minor repair the resources of the farmer and his family should be adequate. If not they should be made so. There is a very definite place in our educational program for vocational or manual training courses which will familiarize farmers and farm boys with common hand tools needed to keep buildings in good repair just as there is a place for a program of mechanical equipment maintenance. The "farm shop" is a real necessity on every farm. However, this is far from saying that every farmer should function as a contractor whenever a major building project comes up. In this case his comparatively superficial understanding of building practices and materials will enable him to contract wisely, and help him to get value received. In the large majority of cases he will get anything but value received if he undertakes mechanical performance himself.

If my arguments against farmer construction are sound, and if the farmer now has nobody to do it for him, then it is obvious that the building industry should take definite steps to fill the gap. Rural dealers many of whom are also builders and rural contractors should position themselves to provide an adequate "agricultural engineering" service to agriculture. On another occasion I recommended a possible solution which I should like to repeat here. Agricultural extension services should direct their farm structures activities to rural builders. These activities should involve teaching design principles, functional requirements, sound construction practices, and encouraging the development of simple but adequate contractural relations between builders and their farmer clients. No doubt before this can be done to the required extent, considerable research will be needed.

Until the gap is filled, until farmers have available the same type of professional and mechanical services which are considered essential by the urban owner, they will have to continue to get along as best they can. But because our present setup is weak at this point is no good argument for encouraging the continuation of a further weakness except as an interim makeshift.

Door and Window Design for Dairy Barns

(Continued from page 24)

that gutters be pitched neither crosswise nor lengthwise, holding that brooms or brushes readily handle excess water after washing. Unless barn management includes facilities for liquified manure removal from storage pit, all gutter and manger drains should be fitted with tight covers and the drains used only for dispersal of wash water. High front mangers are considered more sanitary than sweep in; the latter may also injure the cows' knees, although many poorly constructed high front mangers result in cows throwing the hay out and in greater feeding labor costs. If a stable ceiling is sheathed, the material must be tight and preferably protected by an under layer of well-lapped, vapor-resistant paper in order to prevent penetration of moisture and possible condensation in the space between ceiling and mow floor.

In order to protect the sills against condensation rot, some structural engineers recommend that the sills be placed at or only slightly above the barn floor level, raising the floor above grade enough for ground splash clearance. In this way the sill is said to remain at more nearly floor and ground temperature levels. The floor is extended up the sidewalls 8 to 12 in in the form of a dado, with the inside barn finish resting down against the upper dado edge. This gives an easily cleaned floor-to-wall connection. The difficulty occasionally experienced with manger concrete pitting and wearing can be overcome by using waterproof cement in the finish coat and aggregate of emory or carborundum.

Only a few such points can even be mentioned within the limits of this paper, which is primarily a plea for greater detail of instruction and the application of well-known principles in dairy barn planning. One might include drawings and specifications as a part of each plan, or it may be preferable to get out a master sheet of such details and include them in each set of plans distributed.

Making Hay with an Automatic Tying Pickup Baler

By E. W. Schroeder and W. F. Ackerman

MEMBER A.S.A.E. ASSOCIATE A.S.A.E.

IN 1941 Wilhelm Vutz, then chairman of the A.S.A.E. Committee on Hay Harvesting and Storage, reported, "It looks as if during the next few years the whole problem of handling hay will be in a somewhat fluid state." That well describes the status of hay handling methods to date. Some methods being enthusiastically accepted a few years ago are beginning to lose popularity in some localities, while still gaining in others.

Interest in hay handling with the pickup baler has expanded in the last few years. Whether this is due to the economics of the process, the psychological effect of being able to do a job neatly, or to the wartime labor shortage has not been determined.

However, the possibilities of pickup baling were indicated in the report[1]* of the Committee on Hay Harvesting and Storage in 1942. "If a successful pickup baler could be devised that was as simple to operate as present-day grain binders, then hay baling might have such sweeping advantages from the labor standpoint that regardless of other considerations it would be widely adopted, and, in fact, become the almost universal hay-making practice." A fully automatic tying pickup baler practically meets these specifications. From the past three years' experience at the Pennsylvania State College, some of the possibilities and limitations of this type of machine can be reported upon. During this time over 400 tons of hay were baled and fed on the College farms. Records were kept on power, machinery, and labor requirements, as well as some detailed studies being made on moisture and density relationship affecting the keeping qualities of the hay.

In 1942, the first year the baler was used, 132 tons of hay were put up on which accurate records were kept. The bales averaged 49 lb original weight. The total time required to bale, haul and store this quantity was 45 hr, or at a rate of approximately 3 tons per hour. This rate includes all minor stops and delays which occur during long periods of baling. During the summer of 1944 after two years' experience, it was common for the crew to average 4 tons per hour on a day's run, the hourly rate for short periods going as high as 5 tons per hour.

Since the hauls were usually long — a mile or more — most of the hay was baled and stored with a 7 or 8-man crew — one man on the tractor, two on a wagon drawn behind the baler, one man hauling and two or three men at the storage, and one man tending the baler. The latter may not be required and often is not used, especially with an experienced crew. At four tons per hour this crew was able to bale and store hay at the rate of one ton per 2 man-hours, and on short runs one ton per 1.8 man-hours.

To bale and place hay in storage as fast as it was baled required a minimum crew of six men. In some types of storage this will require the use of a small elevator. A crew of this size presupposes a short haul so the man hauling can help unload and return while the wagon behind the baler is being loaded. Thus one man at the storage was eliminated as was the man attending the baler. Since the baling rate was not materially changed when the baler was operated with a six-man crew, hay was baled and stored with a labor requirement of 1.2 to 1.5 man-hours per ton.

When the bales were dropped from the baler to be picked up later, the labor requirement increased due to an additional man needed for loading. This practice is usually followed in custom baling with a one or two-man crew operating the tractor and baler. When a two-man crew is used, the man who rides the baler occasionally removes the loose hay that may interfere with the knotter, and changes the tension on the tension bars to alter the density of the bales if there is a noticeble variation in moisture content. Some operators prefer a one-man crew. One farmer with whom we worked baled over 900 tons of hay in the summer of 1944 without anyone tending the baler. He averaged about four tons per hour during a day's run, with an average of only four to six missed bales per day. Often one missed bale means two or three because the missed bale is not noticed until it is out of the chamber, unless a man is riding on the baler.

This paper was presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at New York, New York, September, 1944.

E. W. SCHROEDER and W. F. ACKERMAN are, respectively, assistant professor and instructor of agricultural engineering, Pennsylvania State College.

*Superscript numbers denote the references appended to this paper.

A field view of the automatic pickup baler used in the studies at Pennsylvania State College

The rate of baling and the ability of the operator to make well-shaped bales is influenced by the manner in which the hay is raked. In order to form uniform bales, well tied, the windrow must be fairly uniform in size and especially free of bunches followed by thin places. The hay should also be fed into the baler at the proper rate. The bales are likely to be longer at the bottom if the hay is fed in too slowly or longer at the top if the hay is fed in too rapidly. An experienced operator gauges the feeding rate by the sound of the engine on the baler, keeping it well loaded. If two or three swaths of the side-delivery rake are thrown together in hay of average yields, the tractor pulling the baler is usually run in low gear. With smaller windrows it is usually necessary to run in second gear to operate the baler to capacity and make well-tied bales.

Hay that is to be field baled must be field dried. The weather hazards and other problems of field drying, to which at the present time there is no complete solution, must still be coped with. From preliminary reports the newly developed mower-crusher and mow drying with forced ventilation offers some encouragement. However, good practices for field drying can greatly reduce these hazards. A number of investigators[2, 3], have pointed out the importance of early windrowing to shorten the drying time, reduce leaf loss and prevent bleaching. That this practice be followed when hay is field baled is all the more important because it is absolutely necessary that the hay be uniformly dry. Wet bunches of hay that may be scattered by other methods while storing go into the bale more or less intact causing a molded spot in the bale. Grass that is exceptionally heavy or down may be inclined to bunch while being mowed. When these conditions exist early raking encourages more uniform drying.

The moisture content at which hay may be field baled without spoiling has been variously reported from 20 to 33 per cent[3, 4, 5]. Methods of determining moisture, basis for reporting moisture content, methods of collecting samples, density of bale and what is meant by spoiled hay suggest reasons for such a wide range of reported moisture content at which hay may be field baled and stored without spoiling.

Per cent moistures herein reported were determined by drying the samples in a vacuum oven at 100 C and 21 in of mercury until the time-weight curve became practically flat, and the per cent of moisture calculated on the wet basis[6] which is the accepted standard of agricultural chemists for reporting moisture in hay and similar products.

Previous studies had shown that the critical moisture for field baling was around 25 per cent. To find out what happened to hay when baled at different densities with the moisture content above 25 per cent, samples were taken from the part of the windrow from which each bale was made and tagged. The bales were weighed, measured and stored in the haymow of a dairy barn with a barn floor common in dairy sections of the country. The bales were stacked in the barn alternating the direction of each tier. They were packed rather loosely allowing the

uneveness of the bales to provide air space between bales for circulation. Out of several hundred bales that were tagged and observations made for quality, temperature records were kept on 25 bales with thermocouples and thermometers. When the bales were removed from the mow, they were reweighed. Assuming that the entire loss of weight was moisture lost, which can be done since the temperatures remained low[7], the moisture content of each bale was determined individually, which checked with the samples taken originally. Two months after the hay was stored, observations on quality were made by a professor of agronomy whose specialty is forage crops and two dairy professors who were responsible for buying considerable hay for the dairy research herd. All three of these men judged the hay as number 2 grade. The results of this study on a hundred bales of mixed hay are given in Table 1. Usually good drying weather permitted the hay to be baled on the same day it was cut. The yield from this field was 2 tons per acre.

TABLE 1

Bale density, lb per cu ft	Moisture content, per cent	Temperature range, F	Remarks on quality
6 to 8	25 to 28	74 to 76	Color good. Very little or no dust.
8 to 10	25 to 28	96 to 100	Slight off color — scald. Little dust or dusty. Small mold spots in one bale.
8 to 10	20 to 25	75 to 79	Color good. Little or no dust.

The results shown in Table 1 indicate that hay field baled at 25 to 28 per cent moisture should be tied as loosely as possible to obtain the best quality hay at this moisture content. At a density less than 8 lb per cu ft, a 16x18x36-in bale weighs less than 50 lb. Hay baled this loosely is preferably stored where it is to be used because the bales will be too loose for additional handling after curing.

While hay from 25 to 28 per cent moisture may be baled at 8 to 10 lb per cu ft without absolutely spoiling, it shows signs of having heated while curing which is substantiated by the indicated temperature rise. The temperatures are also significant from the nutritive standpoint. W. A. Cashmore[3] shows that there is a marked falling off in carotene content when the curing temperature exceeds 90 to 95 F. While this hay was also graded number 2, there was a slight faded appearance to the green color, called a slight scald by one of the judges. Most of this hay was dusty. The dairymen, however, said the dust was not objectionable and called the hay good quality. One bale in this group contained three small molded spots. These results indicate that hay of 25 to 28 per cent moisture should be baled when, due to adverse weather conditions, there is a risk of losing the entire crop or a considerable portion of its nutritive value. If this is done, however, the bale density should be below 8 lb per cu ft, if the best quality hay is to be obtained.

When the moisture of the hay was below 25 per cent when baled, at a density of 8 to 10 lb per cu ft, the green color of the hay was retained. At this moisture content and density the bales withstand a reasonable amount of handling even after being cured without the twine becoming loose, allowing the bale to get out of shape or fall apart altogether.

BALING HAY TOO DRY TENDS TO SEPARATE THE LEAVES FROM THE STEMS

Baling hay too dry, while few leaves are lost, tends to separate the leaves from the stems and also break up the stems, the result being a chaffy hay. There is a tendency to make wetter hay into heavier bales. This is just opposite from the way it should be done.

With a little correlation the above information may be put into terms that will make it usable to the farmer. It is fairly well agreed that 24 to 25 per cent is the best moisture content for putting up loose hay, 28 per cent the maximum. Most farmers have made hay by this method. They are accustomed to judging these moisture contents on the basis of putting up loose hay. When it is safe to put up loose (20 to 25 per cent), it is safe for baling. When it is not quite dry enough to put up loose, but "we'll take a chance and put it up anyway", it is probably near the 28 per cent mark. Under these conditions hay baled loosely (50 lb or less in an 18x16x36-in bale) should be of good quality if it contains no wet bunches. If 70 to 75-lb bales are made, it is likely to be dusty and contain mold spots.

To get an indication of the experience farmers were having with field pickup balers, twenty-two cards were sent out to owners of these balers, of which seventeen were returned. Of those returning the cards, prior to getting balers one had put up hay with a stationary baler, one had chopped hay, and fifteen had put it up loose. The experience of the fifteen previously putting up loose hay are shown in Table 2.

TABLE 2

Moisture content, baled compared with putting up loose	Numbers reporting	Number reporting mold or no mold in various weights of bales — Size of bales: 40 - 50 lb	50 - 60 lb	60 - 70 lb
Drier	2	2, no mold		
Same	11		6, no mold	1, 1 per 100
			3, 1 per 100 molded	1, only when dew present
Wetter	2	1, 1 per 1000	1, seldom	

While pickup baling has developed and is being accepted to the point where it has possibilities of becoming "an almost universal method of haymaking", as with all newer methods, there are limitations that must be met and problems yet to be solved. Haymaking like harvesting grain must be done in a limited time. Therefore, one baler can serve only a limited number of farms. The weather hazard still remains to be reduced. An inexpensive grass crusher to reduce the drying time or barn curing and smaller loose bales so hay may be baled sooner after cutting offer possibilities. The use of bale loaders and elevators reduces manual labor, but a method requiring less time and physical effort is needed for unloading and placing bales in storage.

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2 T. N. Jones, Natural Drying Characteristics of Forage Crops. AGRICULTURAL ENGINEERING, March, 1939.
3 W. H. Cashmore, Higher Quality Hay. Paper and discussions of the Third Oxford Farming Conference, 1938.
4 The Science and Practice of Conservation, Grass and Forage Crops. London, 1939.
5 Agricultural Engineering Record, University of Oxford, June, 1940.
6 A. W. Clyde, AGRICULTURAL ENGINEERING, October, 1943.
7 E. J. Hoffman and M. A. Bradshaw, Journal of Agricultural Research, vol. 54, 1937.

Power to Destroy

(Continued from page 9)

the end would serve agriculture and America better, if it were made to bear its full share of burdens of war and bureaucracy, on exactly the same basis as other forms of business. It is hardly safe to rely for its growth on shifting the tax load to other business which by that very fact may be doomed to disappear.

In rural electrification and crop processing particularly, the work of many agricultural engineers is interwoven with cooperative organization. They well may look askance at projects founded on the shifting sands of subsidy.

PENNSYLVANIA SECTION ORGANIZATION MEETING
This group attended the organization meeting of the Pennsylvania State Section of A.S.A.E. at State College, November 16. Front row on lady's right is R. A. Knight elected first chairman of the Section. Paul J. Newton (left) and E. W. Schroeder (right)— in front of open door on the back row — are vice-chairman and secretary-treasurer, respectively, of the Section. To the lady's left on the front row is the "spark" that set the organization of the Section in motion, R. U. Blasingame

NEWS SECTION

Nominations for 1945-46 A.S.A.E. Officers

THE Nominating Committtee of the American Society of Agricultural Engineers, consisting of H. J. Barre (chairman), C. N. Hinkle, and J. P. Fairbank, have placed in nomination the following members of the Society for the various Society offices to be filled at the next annual election of officers:

For President

J. DEWEY LONG, chief, research department, Douglas Fir Plywood Association

For Councilor

W. J. COULTAS, chief experimental engineer, John Deere Harvester Works, Deere and Co.

B. G. VANZEE, chief engineer, automotive division, Minneapolis-Moline Power Implement Co.

For Councilor

HENRY GIESE, professor of agricultural engineering, Iowa State College

R. C. MILLER, professor of agricultural engineering, Ohio State University

For Nominating Committee

E. L. BARGER, professor of agricultural engineering, Iowa State College

E. L. HANSEN, agricultural engineer, Portland Cement Association

R. C. HAY, assistant professor of agricultural engineering extension, University of Illinois

W. D. HEMKER, in charge of rural electrification, Westinghouse Electric and Mfg. Co.

G. R. SHIER, consulting and sales engineer in farm structures field, associated with Howard E. Sterner Co.

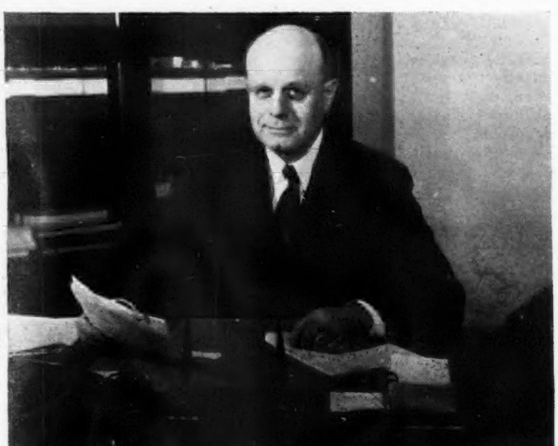
D. C. SPRAGUE, associate professor of agricultural engineering, Pennsylvania State College

The by-laws of the Society provide that by March 1 of each year the Secretary of the Society shall mail each member entitled to a vote a ballot stating the names of the candidates for elective office to be filled at the next election.

Turner Is Ag Engineering Research Chief

ARTHUR W. Turner, president of the American Society of Agricultural Engineers in 1943-44, has been appointed assistant chief of the USDA Bureau of Plant Industry, Soils, and Agricultural Engineering, where he will have full charge of engineering research, Secretary of Agriculture Wickard recently announced.

The appointment, which was effective December 1, foreshadows greater development of all phases of agricultural engineering in the program of the Agricultural Research Administration, according to



This is Arthur W. Turner now in charge of USDA agricultural engineering research

A.S.A.E. Meetings Calendar

January 17 — PACIFIC COAST SECTION, agricultural engineering building, University of California, Davis.

January 26 — MINNESOTA SECTION, Agricultural Engineering Bldg., University of Minnesota, University Farm, St. Paul

February 19 and 20 — SOUTHEAST SECTION, Piedmont Hotel, Atlanta, Ga.

June 25, 26 and 27 — ANNUAL MEETING, Hotel Schroeder, Milwaukee, Wis.

December 18, 19 and 20—FALL MEETING, Stevens Hotel, Chicago

Dr. E. C. Auchter, USDA research administrator. Plans for strengthening engineering research in the Department have been under discussion for some time with a committee of the American Society of Agricultural Engineers.

Mr. Turner, who more recently has been educational adviser of the International Harvester Co., and who prior to joining the Harvester organization in 1927 was associate professor of agricultural engineering at Iowa State College, has taken his new assignment with the understanding that he is to "initiate, plan, develop, coordinate and conduct extensive investigations relating to the application of the science of engineering to the improvement of agriculture."

These investigations are concerned with improvements and developments in farm machinery of all kinds, farm buildings and their construction, transportation of fruits and vegetables, processing equipment for farm products, research relating to electricity on the farm, and combinations of methods and equipment specifically adapted to farms of different types and sizes, including small farms. Under Mr. Turner's direction they will be carried on in close cooperation with state and other federal agencies through an improved organization that includes three major divisions in the Bureau of Plant Industry, Soils, and Agricultural Engineering. These divisions and their projects that are in force at present are as follows:

The Division of Mechanical Processing of Farm Products, of which Geo. R. Boyd is head, is conducting projects at Stoneville, Miss., on cotton ginning machinery and the extraction of foreign material from cotton lint at gins, under the supervision of C. A. Bennett; fiber flax processing investigations at Corvallis, Ore., under the supervision of W. M. Hurst; and sansevieria fiber processing investigations at Boynton, Fla., under the supervision of M. H. Byrom, in addition to the work at the Beltsville, Md., headquarters.

The Division of Farm Mechanical Equipment, of which Roy B. Gray is head, is conducting investigations on pest and plant disease control machinery, on fertilizer distributing machinery, on power and machinery in crop production, and on special equipment.

The work on pest and disease control, under the supervision of Frank Irons, includes studies not only of power-driven ground machines for controlling insect pests and plant diseases, but also of insecticide dispensing equipment for airplanes, with headquarters at Toledo, Ohio.

Fertilizer distributing investigations, under the supervision of G. A. Cumings, include 50 experiments on the placement of fertilizer with 13 crops in 6 states with headquarters at Beltsville, Md.

Crop production machinery investigations are centered on the more urgent problems related to the war. These include studies of peanut production and harvesting machinery, equipment for small (low-income) farms, equipment for crop-residue mulch culture, and machinery for gathering and hulling tung nuts — all under the supervision of I. F. Reed, with headquarters at Auburn, Ala.; studies on sweet potato production and harvesting machinery, under the supervision of O. A. Brown, with headquarters at Ellisville, Miss.; on sugar beet production and harvesting machinery, with headquarters at Fort Collins, Colo., under the supervision of S. W. McBirney, and at East Lansing, Mich., under the supervision of Lorin Smith, and studies on sugarcane production and harvesting machinery with headquarters at Houma, La., under the supervision of R. M. Ramp.

The special equipment investigations, all with headquarters at Beltsville, Md., include studies of insufficient size to justify separate projects and studies preliminary to setting up new projects.

Mr. Gray is also in charge of rural electrification investigations concerned with the utilization of electric power on the farm and including studies of cooling eggs on the farm and at grading stations

and studies of mow drying of hay, under the supervision of A. T. Hendrix, with headquarters at Blacksburg, Va.

The Division of Farm Structures, of which Wallace Ashby is head, is conducting investigations on potato storage, under the supervision of A. D. Edgar, with headquarters at Fort Collins, Colo.; on farm storage of ear and shelled corn, under the supervision of W. V. Hukill, with headquarters at Ames, Iowa; on methods for properly caring for grain in storage, under the supervision of W. V. Hukill, with headquarters at Ames, Iowa, and Hutchinson, Kans., under the supervision of E. R. Gross; on farm storage of grain sorghum, under the supervision of E. R. Gross, with headquarters at Hutchinson, Kans.; and on farm storage of soybeans, under the supervision of Leo Holman, with headquarters at Urbana, Ill. This Division is also concerned with investingations on farm structures of all kinds, including the designing of improved homes and other buildings.

Administrative headquarters for all the agricultural engineering work are in the North Laboratory Building at the Agricultural Research Center at Beltsville, Md., where Mr. Turner has established his office. Mr. Turner is also maintaining an office at the headquarters of the Bureau of Plant Industry, Soils, and Agricultural Engineering, in the administration building of the Plant Industry Station, which is south of Beltsville, Md., along the Washington-Baltimore highway (U. S. Route No. 1) and accessible by bus or street car.

Mr. Turner points out that interested people will find it easy to arrange for visits to the Plant Industry Station and suggests that previous arrangements be made through correspondence or by telephone. Those who plan visits to Washington but do not expect to be able to reach Beltsville can also be accommodated if previous arrangements are made. Conferences can be arranged for in Room 351 of the Administration Building of the Department of Agriculture in Washington. The person whom an interested visitor wishes to see can be in this Washington office waiting, says Mr. Turner.

Southeast Section Meeting

THE program for the meeting of the Southeast Section of the American Society of Agricultural Engineers to be held at the Piedmont Hotel, Atlanta, Ga., February 19 and 20, is now almost complete, according to announcement by Ray Crow, chairman of the Section. The general theme of the meeting is to be "Trends in a Changing Southern Agriculture."

The first day of the meeting will be devoted to a general program, and the forenoon session, with Ray Crow, Section chairman, presiding, will open with an address by R. H. Driftmier, president of A.S.A.E., on the future outlook for agricultural engineers in the Southeast. Other subjects and speakers scheduled for this session include P. O. Davis, director of the Alabama extension service, who will talk on trends toward greater diversification in southeastern agriculture; W. M. Holsenbeck, chairman of the Georgia association of soil conservation district supervisors, who will discuss the part which the soil conservation districts play in changing southeast agriculture, and Channing Cope, Georgia Power Company public relations officer, who will speak on the intensification of efforts to produce desirable changes in the agriculture of the southeastern states.

The Monday afternoon session, with John R. Carreker, vice-chairman of the Southeast Section, presiding, will open with a talk by M. D. Mobley, director of vocational education for Georgia, on the significance of population trends in southern agriculture. Russell Woodburn, a project supervisor of the U. S. Soil Conservation Service, will present a paper on the relations of soil physics to tillage; Jesse B. Brooks, Kentucky extension agricultural engineer, will discuss extension methods in farm building work, and Paul DeLeon, dehydration specialist, of Cleaver-Brooks Co., will present a paper on mechanical dehydration versus field curing of feed crops.

Three concurrent group programs are scheduled for Tuesday forenoon, February 20. These will be devoted to three of the main branches of agricultural engineering, namely, power and machinery, soil and water conservation, and rural electrification.

The power and machinery group session, at which Wm. E. Meek, vice-chairman of the Southeast Section, will preside, will open with a symposium on the mechanization of special crops which will include contributions on peanuts and soybeans, by J. T. McAlister of the U. S. Soil Conservation Service; on sweet potatoes by O. A. Brown of the USDA Bureau of Plant Industry, Soils and Agricultural Engineering; on the mechanical cotton picker by Chas. A. Bennett, also of the BPISAE; on the flame cultivation of row crops by Proctor Gull, and on the development of unit equipment for tractors (speaker to be selected). In addition to this symposium, J. B. Wilson, Alabama extension agricultural engineer, will talk on how extension work in farm machinery can be made more effective, with discussion by H. M. Ellis, North Carolina extension agricultural engineer.

The group program on soil and water conservation, with John R. Carreker, vice-chairman of the Southeast Section presiding, includes four papers as follows: Stream gauging and its application to the agricultural use of small streams *(Continued on page 32)*

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AMODYNS	Stumping Expl.	APCODYNS
Str. 65%	Str. 30%-65%	Str. 65%
Vel. 5800-10,000	Vel. 7400-9000	Vel. 7000-9000
Den. 118-173	Den. 133-165	Den. 128-180

PERMISSIBLE

COALITES	APCOLS
Str. 55%-60%	Str. 60%
Vel. 6000-10,000	Vel. 4500-7000
Den. 133-244	Den. 133-178

NITROGLYCERINE DYNAMITES

FARMEX Ditch.	Nitroglycerine Dyn.
Str. 50%	Str. 20%-60%
Vel. 18,000	Vel. 8800-19,000
Den. 103-108	Den. 105

GELATINS

PERMISSIBLE

GEL-COALITES
Str. 35%-60%
Vel. 8200-16,400
Den. 97-107

AMMONIA

GIANT	PETROGEL
Str. 30%-90%	Str. 60%
Vel. 7000-20,000	Vel. 18,000
Den. 85-100	Large Cartridges

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ATLAS	Blasting Gel.	Oil Well Expl.	PETROGEL H. V.
Str. 20%-100%	Str. 100%	Str. 80%-100%	Str. 60%-100%
Vel. 6500-20,000	Vel. 20,000	Vel. 20,000	Vel.18,000-20,000
Den. 85-100	Large Cartridges	Large Cartridges	Large Cartridges

SEMI-GELATINS

PERMISSIBLE: GEL-COALITES	AMMONIA: GELODYNS
Str. 55%-60%	Str. 65%
Vel. 5900-12,000	Vel.10,000-11,000
Den. 120	Den. 110-128

Str. % Strength.
Vel. Velocity of detonation, feet per second, in the open 1¼" x 8".
Den. Minimum number 1¼" x 8" cartridges per 50-lb. case.

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NEWS SECTION

(Continued from page 30)

and ponds, by M. J. Thomson of the U. S. Geological Survey; soil and water losses as affected by rainfall characteristics, by J. H. Neal, head of the agricultural engineering department, Alabama Polytechnic Institute; irrigation in the Southeast, by Nolan Mitchell, assistant agricultural engineer, Tennessee Valley Authority, and postwar possibilities for privately owned corporations to terrace farmlands and do related work, by W. Forrest Smith, president of the Forrest Smith Terracing Co. An illustrated feature on fencing for greater profit by H. W. Dearing, agricultural engineer of the Tennessee Coal, Iron and Railroad Co., will conclude this group program.

The rural electrification group program, with G. E. Henderson, secretary of the Southeast Section, presiding, includes a discussion of merchandising, engineering, and servicing of electric equipment in rural areas by M. M. Johns, Tennessee rural extension specialist, which will be discussed by L. L. Koontz, division rural supervisor of the Appalachian Electric Power Co. George A. Rietz, manager, farm industry division, General Electric Co., will talk on new equipment and materials in rural electrification.

The meeting will be concluded with a general session Tuesday afternoon, Section Chairman Ray Crow presiding. It will open with a talk by K. J. T. Ekblaw, agricultural engineer, American Zinc Institute, on the postwar farm structures situation. C. L. Hamilton, agricultural engineer, National Safety Council, will present a paper on the subject of safety on the farm, and a review of agricultural engineers' contributions to the war effort will be presented by Raymond Olney, secretary of the Society. A business meeting of the Section will follow this program.

Copies of the program of this meeting will be mailed to all A.S.A.E. members in the Southeast Section late this month, and members in other parts of the country who desire to attend the meeting may obtain copies of the program from the Section Secretary G. E, Henderson, 610 Arnstein Bldg., Knoxville, Tenn., or from Society headquarters in St. Joseph, Michigan.

Report Available on Hay Curing Conference

An attendance of in excess of 200 persons participated in the three-day barn hay curing conference at Knoxville, Tennessee, December 6 to 8, held under the sponsorship of the Southeast Section of the American Society of Agricultural Engineers, in cooperation with the Society's Committee on Hay Harvesting and Storage. Enthusiastic comments have been heard from those who attended, many rating it the best meeting of its kind they had ever attended.

The first day of the meeting was devoted exclusively to two trips to see installations of two hay driers using propeller fans and two using centrifugal fans.

The second and third days of the conference were devoted to round-table conferences. The second day's discussions were devoted to the principles of barn hay curing and the third day to equipment available and in use for curing hay in the barn. An exhaustive summary of the second day's round-table discussions has been prepared by C. E. Frudden, consulting engineer, Allis-Chalmers Mfg. Co., and G. E. Henderson, assistant chief, agricultural engineering development division, Tennessee Valley Authority, has prepared an excellent summary of the third day's round-table discussion. Copies of these summaries are available to A.S.A.E. members on request at Society headquarters in St. Joseph, Michigan.

This picture gives some idea of the size of the group that attended the A.S.A.E. barn hay curing conference at Knoxville last month

NEWS SECTION

(Continued from page 32)

Tennessee Section Elects Officers

AT ITS annual fall meeting held in Knoxville on December 9 the Tennessee State Section of the American Society of Agricultural Engineers elected W. J. Browder, assistant extension agricultural engineer, University of Tennessee, as the new chairman of the Section for the ensuing year. W. C. Gillham, associate agricultural engineer, Tennessee Valley Authority, and G. M. Petersen, assistant professor of agricultural engineering, University of Tennessee, were elected vice-chairman and secretary-treasurer, respectively.

The meeting drew an attendance of 17 A.S.A.E. members and 16 visitors. It was opened with a short business session, including election of the above-named officers, which was followed by a technical program.

Dr. Eric Winters, professor of agronomy, University of Tennessee, presented a paper on the subject "Potentialities of Various Soil Provinces in Tennessee," in which he not only gave an excellent discussion of the soils of the state, but also showed the considerable advantages to be gained by cooperation between agronomists and agricultural engineers in planning soil conservation work.

A second paper, entitled "Drainage Problems in Western Tennessee," was presented by E. L. Edwards of the U. S. Soil Conservation Service, in which he pointed out the extent of the area in the western part of the state requiring drainage and some of the steps being taken to solve drainage problems in this area.

The program of the meeting was concluded with the showing of a motion picture in color, entitled "Living Rock", which depicts some of the many advantages of good soil conservation practices. This picture was produced under the auspices of the University of Georgia.

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

C. F. Anderson, technical representative, J. I. Case Co., Export Dept. (Mail) c/o J. I. Case Co., Garay 1, Buenos Aires, Argentina.

Adrian St. J. Bowie, chief engineer, Bean-Cutler div., Food Machinery Corp. (Mail) P.O. Box 760, San Jose, Calif.

Lillian Castell, assistant advertising manager, Western Mineral Products Co., 1720 Madison St., NE, Minneapolis, Minn.

Lawrence C. Felder, farm production equipment specialist, General Electric Supply Corp., 1260 Boston Ave., Bridgeport 9, Conn.

John T. Gaillard, Jr., engineering specialist in marketing facilities, Alabama Agricultural Extension Service, Auburn, Ala. (Mail) 442 Wright's Mill Road.

Lloyd J. Hersh, vice-president, Lehigh Fan and Power Co., (division of Heilman Boiler Works), Allentown, Pa.

Basil B. Howell, district manager, Rilco Laminated Products, Inc. (Mail) 800 Sabine St., Huntington, Ind.

Allan R. Hunsicker, control of material and inventory, New Holland Machine Co., New Holland, Pa. (Mail) 217 W. Main St.

H. V. Jones, manager, shell crushing plant, Bogue C Hitto — Preal River Soil Conservation. (Mail) Box 507, Clinton, La.

Joseph F. Kolling, layout and detail design, J. I. Case Co., Racine, Wis. (Mail) 3010 17th St.

John H. McCavitt, civil engineer, Soil Conservation Service, USDA. (Mail) Main St., Half Moon Bay, Calif.

Herbert A. C. McGrath, special field representative farm building development, Weyerhaeuser Sales Co., 1st National Bank Building, St. Paul, Minn.

Howard B. Rapp, managing partner, Towner Manufacturing Co., Santa Ana, Calif. (Mail) P.O. Box 264.

Lynn A. Saylor, advertising and sales promotion manager, Certain-teed Products Corp., 120 S. LaSalle St., Chicago 3, Ill.

Harvey W. Steiff, farm engineer, Western Mineral Products Co. (Mail) Britt, Iowa.

TRANSFER OF GRADE

Robert P. Beasley, Lt. (j.g.), general construction, USN. (Mail) 56th Naval Const. Batt. FPO, San Francisco, Calif. (Junior Member to Member)

E. S. Shepardson, extension instructor, department of agricultural engineering, Cornell University, Ithaca, N. Y. (Junior Member to Member)

NEWS SECTION

(Continued from page 34)

Washington Section Activities

AT THE meeting of the Washington (D.C.) Section of the American Society of Agricultural Engineers, held November 30, about 80 A.S.A.E. members and visitors were present to hear Dr. E. C. Auchter, administrator of the USDA Agricultural Research Administration, speak on the ARA program. Dr. Auchter outlined the work of the several bureaus of the ARA and emphasized the important role played by agricultural engineers in carrying out urgent war work. He illustrated the value of combining the efforts of several research bureaus and other governmental and private agencies in accomplishing various urgent tasks by relating how the numerous problems involved in dehydrating meat were solved in record time. In his closing remarks he emphasized that the contribution of agricultural engineers in the work of the ARA should not be limited to execution of programs planned by others; he feels that the agricultural engineers should also take part in the planning of research programs along with other members of the scientific and technical staffs.

At the December 6 meeting of the Section, some 300 employees and officials of the USDA and other agencies, in addition to A.S.A.E. members, were in attendance to hear Wheeler McMillen, editor of "Farm Journal and Farmer's Wife" and president of the National Farm Chemurgic Council, discuss agriculture's future frontiers. Mr. McMillen's inspiring address was a challenge to agricultural engineers and other technical and scientific workers to increase their efforts towards discovering the laws of nature and utilizing them in supplanting the muscles of man and beast in the production of food, shelter and clothing throughout the world. He concluded his address by expressing the hope that engineers and scientists everywhere will be able to build a better world faster than misguided statesmen and politicians can tear it down.

Arthur W. Turner was given an ovation by those in attendance at the meeting, with the announcement that he had just recently arrived in Washington to take up his duties as an assistant chief of the BPISAE, USDA.

Minnesota Section Organized

THE Council of the American Society of Agricultural Engineers, at its meeting last month in Chicago, approved a petition of members of the Society residing in the state of Minnesota to organize the "Minnesota Section".

An informal organization of Minnesota members of the A.S.A.E. has been in existence for about a year, with Charles P. Wagner, manager, farm service department, Northern States Power Co., as chairman, and Philip W. Manson, assistant professor of agricultural engineering, University of Minnesota, as secretary. The executive committee of the group consisted of Mr. Wagner, Mr. Manson, A. R. Schwantes, agricultural engineer, Insulite Division, M. & O. Paper Co., and Carl Widseth, service manager (Northwestern Region), Harry Ferguson, Inc.

The group will hold its first meeting on January 26 as the official Minnesota Section of the A.S.A.E., at which time newly elected officers will be installed, consisting of A. R. Schwantes, chairman; R. A. Glaze, chief engineer, Weyerhaeuser Sales Co., as vice-chairman, and Mr. Manson, secretary-treasurer. The meeting will be held in the Agricultural Engineering Building, University of Minnesota, University Farm, St. Paul. A.S.A.E. members, who are not members of the Section, will be welcome at this meeting.

Personals of A.S.A.E. Members

Tom Elleman is now employed in the engineering department of the Continental Motors Corporation at Muskegon, Michigan, having resigned as chief engineer of the Bolens Products Company.

Gerald A. Karstens, until recently connected with the Missouri River division office of the U. S. Army Engineer Corps at Omaha, is now assistant agricultural engineer of the U. S. Soil Conservation Service and is located at Alma, Wis.

Clarence T. Rasmussen has resigned as engineer for the Bean-Cutler Division of the Food Machinery Corporation to become chief engineer of Killefer Manufacturing Corporation, a subsidiary of Deere and Company.

PROFESSIONAL DIRECTORY

RATES: Announcements under the heading "Professional Directory" in AGRICULTURAL ENGINEERING will be inserted at the flat rate of $1.00 per line per issue; 50 cents per line to A.S.A.E. members. Minimum charge, four-line basis. Uniform style setup. Copy must be received by first of month of publication.

EMPLOYMENT BULLETIN

The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any Notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.

POSITIONS OPEN

AGRICULTURAL ENGINEER wanted by the Allahabad Agricultural Institute, Allahabad, India, for teaching position. Minimum qualifications, degree in agricultural engineering and some farm experience. Postgraduate degree desirable. Duties would be primarily teaching, but some opportunity to participate in research and extension. Candidate must be active Christian interested in mission work. Discharged veteran with slight handicap eligible, if in good health otherwise. Applicants may correspond with Mason Vaugh, 1462 Beall Ave., Wooster, Ohio, or Board of Foreign Missions, Presbyterian Church in U.S.A., 156 Fifth Ave., New York 10, N. Y.

DISTRICT MANAGER wanted for western New York. Experience in the sale of dairy farm equipment helpful, but not essential. Must have automobile. Postwar future. Salary, expense allowance, commission, and bonus. Thorough field training, during which salary and expenses are paid. Write in detail, stating age, education, experience, and at least three character references. PO-175

RESEARCH ENGINEER wanted for work in farm structures and rural electrification in a land-grant college in a north central state. A young man is preferred. Salary will depend upon qualifications. Write giving full details of education, experience, draft status, and other particulars. PO-174

FACTORY MANAGER with agricultural engineering background wanted to take charge of a small factory producing barn equipment and hay tools. A permanent position for a man with executive ability and one who is interested in research and development. In first letter give full details as to education, experience, family status, age, etc. PO-173

SALES MANAGER wanted. An old-established, expanding company in western New York employing about 150 persons requires the services of a man experienced in the sale of farm machinery. When applying, give full details as to experience, family, salary, etc. PO-172

MECHANICAL ENGINEER and draftsman required by expanding farm machinery plant with postwar future. Please give full details as to education, experience, qualifications, draft and family status and present salary. Include photograph if possible. PO-171 *(Continued on page 40)*

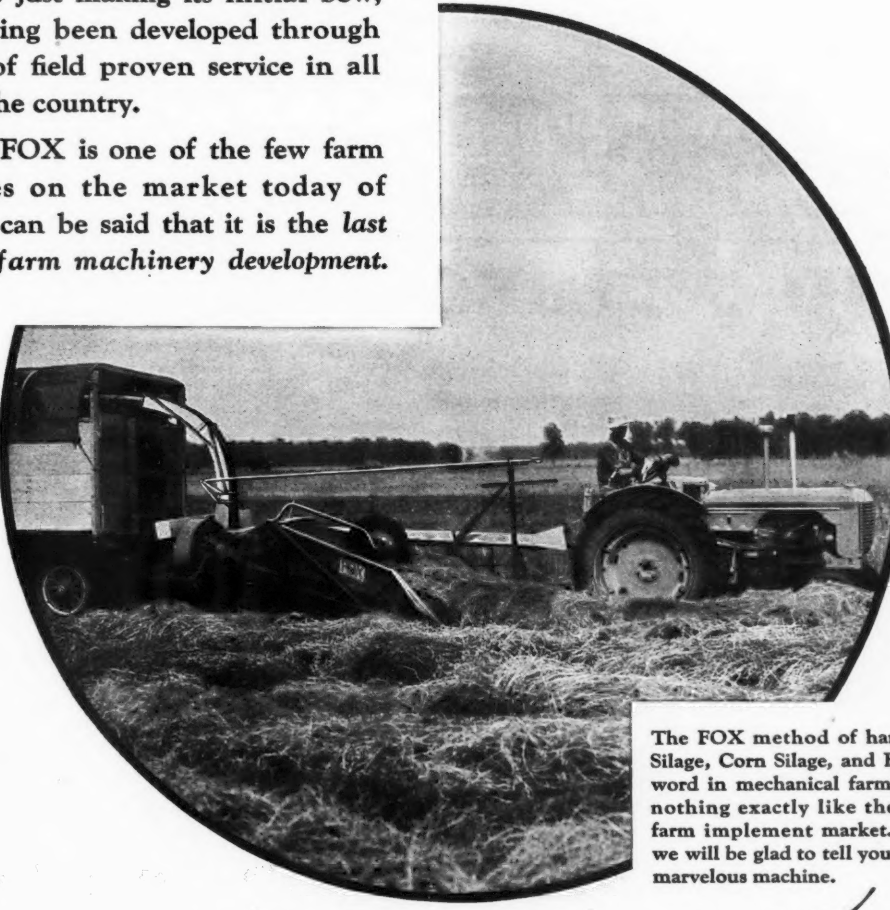
FOX *The*

FARM MACHINE OF TOMORROW *Today*

IN every sense of the word the FOX Forage Harvester, with its Pick-up, Mower Bar and Corn Harvesting Units, is the *Farm Machine of Tomorrow.*

When Pearl Harbor interfered with normal Farm Machine development, FOX was just making its initial bow, after having been developed through 6 years of field proven service in all parts of the country.

The FOX is one of the few farm machines on the market today of which it can be said that it is the *last word in farm machinery development.*



The FOX method of harvesting Grass Silage, Corn Silage, and Hay is the last word in mechanical farming. There is nothing exactly like the FOX in the farm implement market. Write us — we will be glad to tell you all about this marvelous machine.

R. C. Krueger
Secretary

FOX RIVER TRACTOR COMPANY

Pioneers of Modern Forage Harvesting

1815 NORTH RANKIN STREET

APPLETON FOX WISCONSIN

EMPLOYMENT BULLETIN

(Continued from page 38)

AGRICULTURAL ENGINEER (graduate) specializing in farm structures wanted for resident job in Northwest in plywood research on laboratory and agricultural construction projects. Good personality, initiative, ability to organize and complete projects, and ability to write reports and address technical groups required. Give personnel record, photograph, specimens of draftmanship and technical report writing and salary expected with application. Special consideration given ex-service men. PO-169

ENGINEERS, DRAFTSMEN wanted by a well-known manufacturer of farm and garden implements to develop and design new tools, garden tractors and equipment. Positions permanent. Write giving age, salary expected, and full qualifications. PO-168

FARM STRUCTURES MAN wanted by large company for expanding program in prefabricated farm buildings and components. Excellent opportunity for man qualified in functional phase of design and promotion. Replies should indicate scope of training and experience. Confidential. PO-167

SALES ENGINEER wanted for permanent position with small company producing well-accepted building material products. Substantial base salary, better than average proposition for man with liking for sales work and knowledge of building construction. Give full information on past experience and earnings expected. PO-166

AGRICULTURAL PRODUCT ENGINEER wanted for mechanical designing and development of corn pickers, combines, and other harvesting machines. Permanent position with old well-established midwest manufacturer with national distribution. Located in fine city with adequate housing and educational facilities. Big postwar farm market assures future. Salary open. Good opportunity for advancement. Write experience, qualifications, draft status, and other particulars in your letter. PO-165

AGRICULTURAL ENGINEER wanted by a well-known national organization to engage in sales promotion work on farm buildings, preferably someone in his early thirties with good engineering training and farm background and with plenty of initiative and ingenuity. Special training in farm buildings would be helpful to person selected. Discharged service men will receive special consideration. Write giving full details as to education, experience, etc. PO-164

SALES ENGINEERS, preferably 32 to 38 years of age, with college education in engineering and with sales experience, are wanted by a large national manufacturing organization to engage in the sale of farm buildings through dealers. While a postwar project, qualified applicants will be interviewed now. Special consideration will be given discharged service men who have qualifications sought. Write giving full particulars as to education, experience, etc. PO-163

POSITIONS WANTED

AGRICULTURAL ENGINEER with B.S. degree in agricultural engineering from the A. & M. College of Texas is available for employment. Reared on farm with experience and knowledge of operating, repairing and caring for farm machinery. Experienced in farm shop and wood working tools, farm buildings and animal husbandry. Eight years in public school teaching work. Two years in structural aircraft detail and layout drafting. Age 33. Married, with two children. Would like position in design and experimental work on farm machinery. PW-366

RESEARCH ENGINEER (electrical-agricultural) is available. Has a bachelor of science degree in electrical engineering (1933), master's degree in agriculture (1934), degree of agricultural engineer (1939) and is now working for a Ph. D.; also has engineering license. Temporarily employed as an extension electrical-agricultural engineer on wartime food production problems. Ten and one-half years' experience since earning master's degree in agriculture; four and one-half years' in government civil service, and five and one-half years' in other than government service. Born and reared on a farm. Thirty-four years of age, married, two children. Available at a salary range of from $4000 to $8000 per year. PW-365

AGRICULTURAL ENGINEER with a B. S. degree in agricultural engineering from an eastern college is available for employment. Experience in soil conservation, drainage, and use of explosives in land drainage and land clearing; farm reared with experience and knowledge of the operation, care, and adjustment of farm machinery and equipment, also wood-working equipment and farm building construction. Age 38, married, two children. Would like position in teaching, research, or extension work. PW-362

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